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DEVELOPMENT OF AN EXAMPLE 10-YEAR AIR QUALITY MAINTENANCE PLAN FOR THE DENVER AQMSA

Frank A. Record, et al

GCA Corporation

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This report presents an example plan for the attainment and maintenance of air quality standards in the Denver Front Range Air Quality Maintenance Study Area. This is one of four such demonstration maintenance plans prepared as part of the development and testing of guidelines for air quality maintenance planning. The study area includes Denver, Colorado, and nine nearby counties; the planning period is 1974 to 1985. Pollutants for which analysis and planning were done include carbon monoxide, oxides of nitrogen, photochemical oxidants, and total suspended particulates. Separate strategies are recommended for short-term (attainment) and long-term (maintenance) aspects. Maintenance strategies were based upon and coordinated with on-going comprehensive regional planning for the Denver region. The report discusses the study area characteristics, emission allocation and projection methods, air quality data and forecasts, and strategy selection; and includes background information on emissions, regulations, and detailed calculation techniques.

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by

GCA Corporation, GCA/Technology Division

Burlington Road,
Bedford, Massachusetts 01730

Contract No. 68-02-1376

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This report was prepared as a demonstration of the administrative and technical procedures available for preparation of an air quality maintenance plan. Because this was a demonstration exercise rather than an official plan and because time and resources were quite restricted it was necessary to make certain compromises in data collection, analysis, and plan preparation. In using this report readers are cautioned that some numerical results may need refinement before being used for setting policy or selecting pollution control measures. No quantitative results in this report are known to be greatly in error but neither should they be regarded as precise. GCA/Technology Division would be pleased to assist any reader who wishes guidance on using any of the specific data herein.

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EXECUTIVE SUMMARY

INTRODUCTION

The report summarized herein was commissioned by the U.S. Environmental Protection Agency (EPA) in 1974, as a test and demonstration of the techniques for the preparation of plans for the maintenance of air quality for the ten-year period from 1975 to 1985. The report contains a draft plan for both attainment and maintenance of air quality standards in the Denver Front Range Air Quality Maintenance Study Area (AQMSA).

Maintenance plans, such as the example plan presented in this report, are required by EPA regulations as a supplement to the air quality planning in State Implementation Plans which related primarily to the initial attainment of air quality standards. Maintenance planning is directed towards ensuring the air quality standards will not be violated over the long term.

The report is organized as follows.

Section I - This section provides an introduction, and summarizes the difficulties encountered by the consultants in preparation of the example maintenance plan, with an emphasis on what improvements are needed in the data and techniques for the planning process.

Section II - This section provides the physical, socioeconomic, and legal setting of the Air Quality Maintenance Study Area (AQMSA).

Section III - A review of the emission allocation and projection methodologies used for determining the air quality in 1975, 1980, and 1985 is given.

Section IV - An assessment of existing and future air quality is then provided, forming the basis for the quantified approach to the formulation of the Air Quality Maintenance Plan (AQMP).

Section V - A contingency air quality attainment strategy is presented in this section.

Section VI - This last section consists of the air quality maintenance strategy for the AQMSA. Descriptions of the measures, their legal foundation (existing and proposed), and the roles of agencies involved in the strategy implementation are given.

A summary of the above-mentioned report sections follows.

SECTION II--DENVER AIR QUALITY MAINTENANCE STUDY AREA REGIONAL SETTING

In order to develop appropriate and effective air quality maintenance measures, it was necessary to achieve a thorough understanding of the regional and community setting. Section II includes an extensive presentation of the physical and socioeconomic setting, including topography, climatology, meteorology, hydrology, land use, transportation system, demography, employment and residence patterns, institutional arrangements, and related characteristics. Also presented in this section is a discussion of present organizations and measures for controlling air pollution in the AQMSA.

Characteristics of Denver Front Range AQMSA

The Denver Front Range Air Quality Maintenance Study Area (AQMSA) includes the Metropolitan Denver Air Quality Control Region (AQCR), containing

Adams, Arapahoe, Boulder, Clear Creek, Denver, Douglas, Gilpin, and Jefferson Counties, and Larimer and Weld Counties of the Pawnee AQCR. The AQMSA extends eastward from the Continental Divide into the plains, with the major urban centers located along the foothills of the Rockies. The greater Denver area lies within the South Platte River drainage basin with the City of Denver having an elevation in excess of 5,000 feet above sea level. Roughly 20 miles to the west the mountains reach elevations of 10,000 to 14,000 feet; to the southwest, the land rises more gradually along the South Platte River valley. The principal areas of concern for the development of the Air Quality Maintenance Plan (AQMP) are the population centers along the eastern foothills. In addition to the City of Denver, the AQMSA includes the major urban centers of Boulder, Longmont, and Broomfield in Boulder County, Fort Collins and Loveland in Larimer County, Greeley in Weld County and Brighton in Adams County.

The pollutants designated to be of interest in the AQMSA are total suspended particulates, carbon monoxide, nitrogen oxides, and photochemical oxidants. The particulate problem is basically a result of the arid conditions of the region which are conducive to entrainment and re-entrainment of particulates during windy conditions. Fugitive dust, a major component of total particulates, has several man-made sources: unpaved roads, sand on paved roads, agriculture, land development, residential, industrial, and commercial construction, highway construction, aggregate storage, cattle feedlots, and quarrying, mining, and tailings.

The other pollutants of interest, CO, NO_x, and photochemical oxidants, result largely from the extensive use of motor vehicles in the Denver AQMSA. The Denver metropolitan area is characterized by a high growth rate of motor vehicles (5.2 percent per year increase in registrations) and the highest per capita automobile registration in the nation, one automobile for every 1.5 persons. The motor vehicle pollutant problem for the AQMSA is exacerbated by the high elevation of the region since operating characteristics of internal combustion engines and the effectiveness of control devices are functions of ambient air density, with higher altitude generally resulting in higher vehicular emission rates.

Bus transit is now only used by a small portion of the region's population. It was estimated that from 2 to 5 percent of all trips in the Denver region use the bus system. Bus ridership has been steadily increasing in recent years, however. Also, in Denver itself the bus system does carry a significant portion of all trips, accounting for an estimated 20 percent of all central business district-oriented work trips. A major planning and engineering effort is underway at the Regional Transportation District to plan and construct a fixed-guideway mass transit system for the Denver region.

The topography of the region adds to the high ambient concentrations of pollutants. Under light nighttime wind conditions, surface air, made relatively more dense by radiational cooling, drains down the river valley toward the northeast and lower elevations. Thus cold air drainage apparently stops just beyond the suburbs and the shallow air mass, which has accumulated pollutants from city sources, is frequently brought back by a sudden wind reversal around noon. Under a light wind regime, crossing and recrossing of the pollutant source (i.e., the urban area) by the same air mass may continue for several days, thus leading to an excessive local accumulation of pollutants.

An understanding of socioeconomic characteristics of the AQMSA provided important criteria in evaluating the potential effectiveness and applicability of control measures, and in selection of measures for final plan development. The Denver region's population has grown at a fast pace in the past 3 decades, the rate of growth ranging from 3 to 4.6 percent per year. Population is decreasing in the central city as urban sprawl moves to the north and south along the front range. The suburban communities have accounted for approximately 80 percent of the area's population increase between 1950 and 1970. This trend is expected to continue with the percentage of the total metropolitan Denver population residing in Denver County going from 65 percent in 1950 to 25 percent in the year 2000.

General land use trends for the Denver area show agricultural and vacant land being transformed to single-family residential use. Major portions of the urbanized areas in the region are characterized by single-family tract housing, strip commercial developments and a substantial freeway network. Low density and dispersed residential development patterns characterizing the regions are expected to continue with circumferential growth occurring from city centers and radial growth along transportation corridors. Other housing trends, such as a declining number of persons per housing unit and popularity of low density residences, are expected to continue based on existing trends, economic forces and social attitudes.

Approximately two-thirds of the employment growth between 1964 and 1970 occurred in Denver County, while about 95 percent of the population growth was in surrounding counties. This indicates an inward work trip transportation flow for the region. Projected employment density patterns illustrate that employment will not disperse significantly through the region, but will continue to be concentrated in the core region, thus requiring continued commuter traffic. Some services have followed the residential development in the suburbs, but as yet no clear proliferation of industrial development is apparent.

Government Agencies Responsible for Planning and for Air Quality in the AQMSA

As part of the maintenance study, several agencies were contacted for information, for aid, or to understand their potential role in air quality maintenance. The responsibilities of the agencies with major roles in air quality maintenance planning are summarized below.

Colorado Air Pollution Control Commission - The duties of the Colorado Air Pollution Control Commission include the development and implementation of a comprehensive program for prevention, control and abatement of air pollution throughout the entire state, including a program for control of emissions from all significant sources of air pollution; the promulgation of ambient air goals for every portion of the state; the adoption and promulgation of ambient air quality standards and emission control regulations; at its discretion, the hearing and determination of violations and applications for the granting of variances; and, at its discretion, the review of any variance order or determination of the variance board.

Colorado Air Pollution Control Division - The Division is empowered to conduct studies and research with respect to air pollution; determine if the ambient air standards are being violated in any area of the state; investigate actual, suspected, or potential sources of air pollution; furnish technical advice and services; notify any affected jurisdiction of standards which are not being met; and to issue contaminant emission notices. The Division also has the authority to enforce compliance with the promulgated emission control regulations.

The Department of Health, in which the Air Pollution Control Division was established, is designated as the "state agency" for all purposes of the Federal Clean Air Act, as amended, and regulations promulgated under that act.

Colorado Division of Planning - The Division of Planning, in the Department of Local Affairs, serves as an advisory and coordinating agency with no regulatory authority. The duties of the Division of Planning are primarily those of assistance in the gathering and using of data. It also helps to coordinate the planning activities of other departments or agencies, at the state and local level, to ensure a degree of harmony. The population statistics, estimates, and projections prepared, maintained, and interpreted by the Division of Planning are designated as the official data for state government purposes.

Colorado Land Use Commission - The Colorado Land Use Commission was established within the Office of the Governor to encourage planned and orderly land use development. For the past 3 years the Land Use Commission has been working to identify a program that will provide a framework and a process whereby the State of Colorado and its various political subdivisions can guide future development. This has culminated in a report entitled, "A Land Use Program for Colorado," which is briefly discussed in this report. The Land Use Commission recommendations included a development permit system which would apply to all developments located in areas of critical environmental concern and to proposed activities of regional or State significance.

Joint Regional Planning Program - Denver SMSA - The responsible agency for comprehensive planning in the Denver SMSA is the Denver Regional Council of Governments. The responsibility for continuing, comprehensive, and cooperative (3-C) transportation planning rests with the Joint Regional Planning Program (JRPP), a cooperative transportation planning effort carried out jointly by the Denver Regional Council of Governments (DRCOG), the Regional Transportation District (RTD), and the Colorado Division of Highways (CDH). Consistent with its role as intergovernmental coordinator for the SMSA region, the Council of Governments coordinates the joint planning efforts with federal, state and local units and agencies of governments. In carrying out this role, the Council makes application for federal assistance to the planning program, coordinates the planning program with the planning for all modes of transportation, coordinates the needs and findings of the planning program with units of local governments, coordinates with state planning efforts, and, upon adoption, certifies land use and public transportation plans to the federal government. General policy guidelines are established cooperatively by the policy bodies of each agency. The staffs of the Council of Governments, the Regional Transportation District, and the Colorado Division of Highways have responsibility for management and control of the planning elements and tasks assigned to their respective agencies.

Larimer-Weld Regional Planning Commission - The only regional planning commission which has been created in the Denver Air Quality Maintenance Study Area, other than the Denver Regional Council of Governments, is the Larimer-Weld Regional Planning Commission. The Larimer-Weld RPC has developed and adopted a master plan which states the goals and policies for the Larimer-Weld region and provides the development plan for these two counties.

Air Pollution Control in the AQMSA

A review of the State and Federal regulations controlling emissions and providing needed review processes was conducted to determine the extent and impact of the measures already promulgated. In addition, the Colorado State Air Pollution Control Act of 1970, as amended, and the recently enacted House Bill No. 1041 were analyzed to identify the existing legal authority which serves as the basis for the development of maintenance measures.

In general, it was shown that the Colorado State Air Pollution Control Act has provided the legal authority required under Federal regulations and that the Colorado Air Pollution Control Commission has complied with the Federal requirements by having submitted the required Air Quality Implementation Plan for the State of Colorado and the State of Colorado Air Pollution Control Transportation and Land Use Plan. These plans have been reviewed by EPA and found to be conditionally acceptable based upon the control measures therein. EPA has also promulgated regulations to deal with the problem of hydrocarbon and carbon monoxide emissions in the Denver metropolitan area. These regulations, and the ones promulgated by the Colorado Air Pollution Control Commission, are summarized by pollutant in the report.

The legal authority provided by House Bill No. 1041 deals with land use planning measures in Colorado. This law provides that local governments, or the Colorado Land Use Commission, may designate certain areas or certain activities as being of state interest. Such areas or activities must then be administered by the local government in accordance with either guidelines provided by the legislation or by certain state agencies.

SECTION III--EMISSION ALLOCATION AND PROJECTION METHODOLOGY

This section summarizes the procedures used for the allocation and projection of air pollution emissions in the Denver Front Range AQMSA. Geographic distribution of emission sources was known from existing data on carbon monoxide, hydrocarbons/oxidants, and nitrogen oxides, but distributions had to be developed for area source emissions of particulates. Fugitive dust sources received particular attention. All pollutants were then analyzed for their expected future concentrations. Future emissions were forecasted through indirect techniques involving the use of forecasts developed by others for various social, economic, and travel-related parameters.

Data Sources

For the Denver metropolitan area, the best available data for forecasting future air quality was the Denver Regional Council of Governments (DRCOG) projections of growth for the Joint Regional Planning Program (JRPP) area. The use of this data was a reasonable approach because DRCOG is the development commission for this area and will be instrumental in policies affecting the growth of the region. An important implication of the use of this data is that, for the JRPP (metropolitan Denver) area, certain assumptions concerning transportation facilities, population size and distribution, and the existence of certain highway networks are implicit in the estimates.

For areas outside the JRPP area, official state projections were available up to 1980. Additional forecasts were available from county planning commissions and from the Federal OBERS data. Linear interpolation was performed to estimate parameters for intervening years.

Data on both present and projected automobile travel, used for projecting emissions, was supplied by the Colorado Division of Highways. Vehicle-miles traveled (VMT) data was available by highway functional classification and by geographic area. The major problem with this data is that it was given only for the years 1968 and 1990 for non-JRPP areas and for 1972 and 2000 in the case of the metropolitan Denver area. A linear interpolation was used to estimate traffic activity for intervening years.

Point Source Emissions

Projections of particulate emissions from point sources were derived from a review of regulations controlling these emissions and regional forecasts of economic growth. Estimates of 1975 (base year) emissions were derived by applying the regulations to known process rates to calculate maximum emissions. Emissions in future years were estimated by using economic forecasts for each portion of the study area, on the assumption that emissions would be proportional to employment.

Point source emissions of carbon monoxide were found to be negligible, compared to mobile sources, and were assumed to be constant. Hydrocarbon emissions were forecasted based on the control regulations and estimated effectiveness of the EPA-promulgated transportation control plan. Increases in nitrogen oxides emissions from point sources were based upon forecasted changes in population and employment, but were forecasted only for the metropolitan Denver area.

Mobile Source Emissions

Emission densities for CO, HC, and NO_x were derived from the projected traffic data for future years. Projected vehicle-miles of travel per day were supplied by the Colorado Division of Highways for each cell on a grid established for analysis of the Denver area. For each cell the data included the VMT for each type of highway and speeds on each type of highway. Emissions were then calculated, using the EPA emission factors. For this analysis it was assumed that emission standards would be delayed by 2 years and that high-altitude requirements would take effect by 1977. Mobile source emissions were also calculated from projected travel in selected urban portions of the study area outside the Denver metropolitan area.

Area Source Emissions From National Emissions Data System (NEDS)

Projections of increases in emissions of carbon monoxide and nitrogen oxides were not considered because of the minimal impact area sources were known to have on ambient concentrations of these pollutants. Hydrocarbon emissions from area sources were assumed to decrease as a result of existing regulations.

Area source emissions of particulates provided by the NEDS were projected to 1975, 1980, and 1985 on much the same basis as particulate point sources; however, no regulations are applicable to these emissions to provide an initial decrease in emissions. In addition to employment projections by source sector, population growth rates were used to project emissions from the residential sector. Projections of measured particulate emissions as a result of motor vehicles were made by assuming that the total emissions from the motor vehicles grow with the increased VMT. Unlike the direct application of population and employment growth rates to the emissions, the VMT growth rates were reduced by the degree of control of particulate emissions expected due to the installation of catalytic mufflers in new cars.

Fugitive Dust Emissions

The fugitive dust emissions were projected to 1975, 1980, and 1985 by applying the regulation recently promulgated by the Colorado Air Pollution Control Commission and the appropriate travel and socioeconomic growth parameters to the corresponding source sectors for fugitive dust. The fugitive emission reductions were determined for unpaved roads, land development and construction activities, and mining and storage operations, based on the analysis of control measures provided in a previous study by PEDCo, thereby giving a new base line year of 1975 to which the growth factors can be applied.

Several source categories were seen as unlikely to greatly change in activity in the AQMSA during the 10-year period: agriculture; quarrying, mining and tailings; aggregate storage; and cattle feedlots. In addition, it was expected that control measures on an increasing number of unpaved roads would offset increased traffic on present low-volume unpaved roads. Emissions due to sand on paved roads were projected to increase in direct proportion to the total VMT; land development and residential-commercial construction as calculated from JRPP projections of land use; and highway construction activity as projected from the JRPP estimates of land use for roadways.

SECTION IV--ASSESSMENT OF EXISTING AND FUTURE AIR QUALITY

In this section, an assessment is made of the existing and projected future air quality by comparing measured and predicted air quality with the Federal Ambient Air Quality Standards or by comparing predicted and allowable emission density levels. Separate analyses were made for each of the four pollutants under study.

Total Suspended Particulates

Baseline Air Quality Data for Particulates - For particulates, no overall trend in the annual geometric means appeared to occur during the period 1970 to 1973. Since the individual 24-hour concentrations were not yet available for 1973 and the annual data had not yet appeared in SAROAD, the development of base line data was restricted to the years 1970, 1971, and 1972. The selection of the no-trend option provided for the use of a 3-year average annual mean of 130 $\mu g/m^3$ in Denver County. In effect, no air quality base line year was determined for particulates.

Examination of particulates data from 34 sampling stations in the AQMSA showed that the annual secondary standard of 60 $\mu g/m^3$ was exceeded at all sites except three remote or rural sites. The primary annual standard of 75 $\mu g/m^3$ was exceeded at 23 of the 34 stations. Highest concentrations were observed in the commercial areas of downtown Denver where the secondary standard was exceeded about one third of the time. Concentrations exceeding the secondary standard were found to occur most frequently during the months from October through April and least frequently during June or July. However, this seasonal trend appeared to be much less evident in Weld County, where summertime concentrations also frequently violated the secondary standard.

Using a background concentration of 30 $\mu g/m^3$ and the base line concentration of 130 $\mu g/m^3$, it was determined that the required reduction in emissions is 55 percent to meet the primary standard or 70 percent to meet the secondary standard, in Denver County. Substantial reductions are also needed in other cities and are discussed in the report.

Modeling of Particulate Air Quality - Atmospheric modeling was used to provide projections of particulate air quality, thereby helping in the analysis of the spatial concentration pattern and the changes in this pattern due to variations in source strengths during the period of interest. By calibrating the model with the actual air quality measurements, it was possible to project the air quality over a much larger area than that covered by the network of stations.

For purposes of air quality projections, it was decided to apply the Climatological Dispersion Model (CDM) to calculate average annual ground level air pollutant concentrations due to point sources. Area and fugitive dust source contributions were evaluated by means of the Hanna-Gifford Area Source Model. The CDM was chosen for point sources with buoyant plumes since it can account in more detail for the distribution of wind speeds and stabilities in addition to the presence of a mixing layer. The Hanna-Gifford model has the advantage that the air quality within a particular grid square may be related directly to the emission density within that square and those immediately adjacent.

The modeling was performed on the 1972 emission levels for point, area, and fugitive sources, and for 1975 point source emissions to provide an estimate of the impact of the point source regulations on air quality. The percentage contribution of each source sector to the total calculated concentration was maintained and projected to 1975, 1980, and 1985 by use of the emission growth factors derived earlier. By projecting the percentage contributions, new calculated concentrations could be determined as well as new percentage contributions from each source sector. Ambient level air concentrations of particulates were thus calculated for each of the air sampling station locations.

Applying the various growth rates to the contributions from each source sector and adjusting for the background levels, percentage contributions and projected total fitted plus background concentrations for 1975, 1980, and 1985 were calculated. In spite of the SIP attainment strategies, these projections demonstrated that at most sampling sites the secondary standards for particulates would continue to be exceeded and the primary standard would not be attained in the urban areas of the AQMSA. Additional reductions to obtain the primary and secondary standards in 1975 in downtown Denver were determined to be 46 and 64 percent respectively. In the more rural regions, the attainment of the secondary standards required a further reduction of 43 percent.

The projected particulate air quality and the percentage contributions from each source sector indicated that point sources, under current regulations, contribute only to a small degree to the measured concentration of particulates. The contributions from area and fugitive sources are comparable and represent the majority of the emissions contributing to the increased level of particulates.

Carbon Monoxide

Base Line Air Quality Data for Carbon Monoxide - Carbon monoxide measurements were made at only one station in 1971 and 1972 with five additional monitors being added in 1973. A review of the 1-hour and 8-hour concentrations measured indicated that control of the 8-hour concentrations would ensure the attainment of the 1-hour standard also. As no trend could be definitely established, examination of the second highest 8-hour concentrations for the 3-year period indicated that the control strategies would be based on the 1971 second high of 31.6 mg/m^3. Using the concentration of 31.6 mg/m^3, the required reduction in emissions is 68 percent, based upon a linear rollback from 1971 conditions.

No carbon monoxide data were available for portions of the AQMSA outside the Denver urbanized area, but emission densities were calculated for selected cities and compared with concentrations for a comparably sized area in Denver. The result of this comparison was that Denver has by far the highest CO emission density in the area, with only one other city (Ft. Collins) experiencing emission densities high enough to probably violate the ambient standards over a substantial area. Locally excessive concentrations could be occurring in the vicinity of heavily traveled streets, however.

Projected Carbon Monoxide Emissions and Concentrations - Using traffic projections, based upon the JRPP transportation and land use plan, and procedures described in Section III, average carbon monoxide emissions and concentrations were calculated for 240 locations on a grid superimposed over metropolitan Denver. The resulting forecasts show that maximum concentrations of carbon monoxide will occur near the center of the Denver CBD, will decrease markedly over each 5-year period, and will decrease simultaneously throughout the metropolitan area. Thus, reductions in tailpipe emissions due to the Federal Motor Vehicle Control Program more than compensate for the projected growth in vehicular traffic.

Calculations were then made to show the effect of the inspection and maintenance and retrofit control strategies which EPA Region VIII considers will be used as part of the Transportation Control Plan, namely:

1. Semi-annual inspection and maintenance using the idle test mode (failure rate of 50 percent).
2. Air bleed retrofit on pre-1968 light duty vehicles.
3. Air bleed retrofit with exhaust gas recirculation on 1968 to 1974 light duty vehicles.

Strategies 1 and 2 were promulgated by EPA in the official TCP, but strategy 3 is a probable replacement for a high altitude modification proposed originally.

Using the assumption, developed earlier, that a 68 percent reduction in CO emissions will be necessary in 1977 in the Denver core area, the emissions must be reduced by an amount equivalent to 34 percent of the light duty vehicle travel in the core area, even with the tailpipe strategies listed above. If, as is estimated by EPA and is discussed in Section V of the report, the light duty vehicle travel can only be reduced by approximately 15 percent, then the analysis implies that the CO standard will not be achieved before the end of 1979; thus some modification to the assumed strategies must be made if the standards are to be met by 1977. (With only the tailpipe strategies and no reduction in VMT by light duty vehicles, the standards were forecasted to be met by the end of 1980.) Outside of Denver, the analysis showed that the emission densities should be within the allowable amount calculated for Denver without the use of added control strategies; and in Denver, carbon monoxide concentration was predicted to remain within the allowable limits once the allowable limit is achieved.

Photochemical Oxidants

Base Line Air Quality Data for Oxidants - The study of the oxidant concentrations reported since 1970 by a variety of methods, including the approved chemiluminescence method begun in 1973, indicated that the second highest 1-hour concentration of oxidants observed was 490 $\mu g/m^3$ and occurred in 1973. Therefore, 1973 must be the air quality baseline year for strategy determination. Use of this baseline concentration and the relationship from Appendix J of 40 CFR Part 51 showed that the required reduction in hydrocarbon emissions is 82 percent. The use of a straight rollback would predict the need for a 67 percent reduction. It was decided to use the straight rollback basis for computing allowable emissions.

Projected Emissions of Hydrocarbons and Concentrations of Photochemical Oxidants - In a manner similar to that for CO, hydrocarbon emission densities were calculated for the Denver metropolitan area. As was the case with carbon monoxide, the maximum emission densities occur near the Denver CBD and the trend is for reduced emissions throughout the area. Unlike CO, however, emissions from non-mobile sources contribute significantly to the hydrocarbon emissions and were thus added to the vehicular emissions.

Again assuming the tailpipe controls described earlier will be in effect, it was calculated that an additional reduction in hydrocarbon emissions equivalent to 45 percent of the light duty vehicle VMT must be achieved to meet the standards in 1977. With a 15 percent reduction in VMT by light duty vehicles, the standards were predicted to be met by early 1981. With no reduction in VMT the standards would not be met until sometime in 1982. As with CO, it was forecasted that the standards for photochemical oxidants would be met throughout the remaining portion of the maintenance period once the standards are initially achieved.

Nitrogen Oxides

Base Line Air Quality Data for Nitrogen Oxides - The only reported set of nitrogen dioxide measurements made with a currently acceptable analytical method that is also statistically adequate for the determination of an annual mean was collected in Denver in 1972. The annual arithmetic mean obtained from the 6759 1-hour observations made by an instrumental calorimetric method during the year was 73 $\mu g/m^3$.

The measured concentration is thus well below the national standard of 100 $\mu g/m^3$. Hence, no reduction is necessary to initially meet the standards.

Projected Emissions and Concentrations of Nitrogen Oxides - Nitrogen oxide emissions from vehicular sources were calculated using the same techniques as for other vehicular emissions. Little change in emission patterns was predicted for the period of 1975 to 1980, but a substantial reduction in emissions was forecasted for the 1980 to 1985 period, reflecting the emission controls to take effect in the late 1970's. No area was predicted to experience significantly increasing emissions from the increased amount of travel activity. Separately analyzing the contributions from vehicle types showed that emissions from light duty vehicles will increase until 1977 and then decrease, while emissions from heavy duty and diesel vehicles will increase slowly. The maximum total emissions from vehicular sources were calculated to be approximately the same as the 1972 emissions, when the annual mean concentration of nitrogen oxides was only 73 percent of the standard. These calculations therefore showed that a substantial increase in emissions from other sources could be tolerated without exceeding the standards. Emissions from non-vehicular sources could increase at a rate of about 6.5 percent per year from 1972 to 1980, when vehicular emissions were forecasted to begin to decline, without exceeding the calculated allowable emissions. Emissions from non-vehicular sources are actually expected to increase at a rate of only about 2 percent per year. Thus, no violation of the nitrogen oxide standards was predicted for the maintenance period.

SECTION V--CONTINGENCY ATTAINMENT STRATEGIES

The projections of concentrations in the previous section demonstrated that, given previously quantified control regulations and air quality trends, the primary and secondary standards for total suspended particulates, carbon monoxide, and photochemical oxidants would not be achieved by the specified attainment dates. Since the attainment of the desired air quality is an integral part of the Air Quality Maintenance Plan developed, it was necessary to investigate those measures which must be implemented to ensure attainment of the standards.

This section discusses transportation control measures and fugitive dust control measures as a contingency attainment strategy package. The measures are presented as a means of ensuring the effectiveness and integrity of the Colorado SIP as well as the AQMP supplement to the plan. For the State of Colorado, contingency attainment measures are intended to reduce concentrations to the National Ambient Air Quality Standards within the time frame of the 1977 deadline.

Transportation Control Measures

In response to the EPA-promulgated TCP, the Colorado Air Pollution Control Commission recently promulgated Regulation No. 9 which deals with VMT reduction measures: exclusive bus-carpool lanes, park and ride facilities, employer carpooling programs, and employer mass transit incentives. As these control measures have only recently been promulgated, it was not possible to quantify the emission reduction potential of the individual measures. Instead, it was assumed that the maximum possible reductions in VMT was 15 percent of travel by light duty vehicles in 1977.

This reduction in VMT still left another 30 percent reduction in light duty VMT needed for sufficient control of hydrocarbons and 19 percent reduction needed for carbon monoxide emissions, in 1977. The only measure available for increased reduction of emissions, considering the constraints already imposed, was therefore a gasoline sales limitation.

As insufficient data was available for the quantification of the reductions in gasoline sales that would be needed, no control strategy was specifically formulated for this contingency. It was also determined that no further regulations were needed at this time to ensure later strategy formulation since EPA had already promulgated regulations requiring the continuing review of the progress of the transportation control plan and the determination of the measures needed to implement a gasoline sales limitation program.

Fugitive Dust Control Measures

A review of the current regulations for the control of fugitive dust and the study of the fugitive dust problem in Colorado identified some areas where more stringent controls on fugitive dust could be applied. Specifically, this entailed the extension of the current controls to the entire AQMSA instead of just the Priority I area within that region. In addition, control measures for dust from sand on paved roads were suggested.

This strategy was shown to generally prevent future growth in fugitive dust emissions in spite of increased source activity; however, this strategy, by itself, did not bring about the attainment of the primary standard for particulates throughout the AQMSA.

Other Area Source Attainment Measures for Particulates

As all reasonably available control technology (RACT) had already been applied to the point and fugitive dust source sectors without attainment of the particulate standards, a quick investigation of the possible control measures for area sources was conducted. Unfortunately, it was shown that current information did not allow for the formulation of any control measures which could satisfy the need for the attainment of the standards. The use of lead-free gasoline was found to have a minimal impact on the total air quality situation. A potentially powerful control measure on the use of bituminous coal was discarded due to data base uncertainties.

SECTION VI--MAINTENANCE STRATEGIES

The air quality projections generated by this report made use of population and employment projections done by the Joint Regional Planning Program (JRPP). These JRPP numbers reflected the expected growth given the JRPP transportation, highway, and land use plans. As shown in Section IV, air quality maintenance in the Denver AQMSA is no problem once attainment has been accomplished. It was because of this fact that the key elements of the JRPP plan were chosen as the maintenance measures for the region.

This section discusses the JRPP transportation, land use, and highway plans as maintenance measures. Two implementation tools are discussed as means of ensuring maintenance measure realization. These tools are air contaminant emission permits and use of land development permits. Included in the discussion are descriptions of the measure or tool, its legal foundation, as well as the roles played by involved agencies. A final section deals with the social and economic impacts of the maintenance measures.

Maintenance Measures

The transportation plan features a rapid transit system and expansion of bus service within the region. The rapid transit system itself is conceived as 100 miles of two-way guideways with 58 stations interconnected by automatically controlled twelve-passenger vehicles. It is recommended that the transportation plan be incorporated into the official State Implementation Plan. In addition certain regulations to be promulgated by the Air Pollution Control Commission are proposed to provide a framework for incorporating air quality considerations into the detailed planning process and in subsequent changes.

A major feature of the JRPP land use plan is the development of 13 activity centers. These centers are described as aggregations of urban activity large enough to be primary generators of large internal activity. They are expected to be terminal locations for the rapid transit system.

The evolution of these centers is dependent upon the construction of the rapid transit system as well as the JRPP highway plan. Air contaminant emission permits will also serve as a prime tool in activity center creation.

The third maintenance measure is the construction of the approved JRPP highway plan. It is not the purpose here to encourage additional highway construction, but instead to have construction which complements the JRPP public transportation plan.

Implementation Tools

The two primary tools for ensuring the implementation of the maintenance measures are the air contaminant emission permit and the land development permit systems.

EPA regulations (40 CFT 51.18) require that new or modified sources of air pollution be reviewed for their air quality impact before construction or major modification. States must demonstrate that they have adequate legal authority to prevent the construction or modification of new sources of air pollution. Once Colorado has complied with the requirement for indirect source controls it is recommended that the criteria for review of new indirect sources in the JRPP area include the question of compliance with the JRPP plan.

Land development permits are the second implementation tool. Existing legislation requires the issuance of a permit before an area of state interest can be developed. Since interchanges involving arterial highways as well as rapid or mass transit terminals, stations, and fixed guideways are designated as being areas of state interest, this permit system is an important means of ensuring JRPP plan implementation.

Social and Economic Impacts of the Maintenance Plan

The effects of the JRPP plan on social and economic parameters are discussed in order to gauge any negative impacts which air quality maintenance might impose. Social areas analyzed include mobility of the population, relocation caused by rapid transit construction, and reaction of the population to the system in general. Overall, it appears that the JRPP plan through its proposed transportation system will increase mobility while forcing little relocation. The social impact is generally positive.

The economic parameters considered were impacts on employment, income, and business establishment activity. It was shown that employment in the construction sector will increase with system construction and that once the system is in operation labor mobility should improve the job choice of low income residents. The impact on family income was shown to be minor. Lower income families will end up paying as large a percentage of their income to finance the system as upper income families. This is offset to some degree, however, since lower income families are likely to gain most in terms of mobility once the system is in operation. Business establishments are not expected to suffer from the JRPP plan. Some may be forced to relocate to activity centers, however, as spending locations change.

SECTION I

INTRODUCTION

BACKGROUND TO PLAN DEVELOPMENT

This document contains a draft plan for the attainment and maintenance of air quality standards in the Denver Front Range Air Quality Maintenance Study Area, including Adams, Arapahoe, Boulder, Clear Creek, Denver, Douglas, Gilpin, Jefferson, Larimer and Weld Counties and herein referred to as the Denver AQMSA. Pollutants for which attainment and maintenance activities may be necessary are identified as total suspended particulates, carbon monoxide, oxides of nitrogen and photochemical oxidants.

This plan was necessitated by the review of state plans conducted by the Administrator of the United States Environmental Protection Agency. All state implementation plans were disapproved because of their lack of regulations or procedures for ensuring the maintenance of national standards.

Pursuant to Section 51.12, paragraph (e), Part 40 of the Code of Federal Regulations (40 CFR 51.12(e)) all states were required to identify areas that have the potential for exceeding National Ambient Air Quality Standards due to present air quality or the projected growth over the subsequent 10-year period, 1975 to 1985. The above-mentioned area and the associated pollutants were so identified.

Attainment activities were initially outlined in the Air Quality Implementation Plan for the State of Colorado (often referred to as the State Implementation Plan or SIP) for total suspended particulates, carbon monoxide, and photochemical oxidants, necessitating the need for maintenance activities for these pollutants upon the attainment of the National Ambient Air Quality Standards (NAAQS). It was anticipated that nitrogen oxides would also exceed the standards so this problem is also considered herein.

For this area, and any other area so identified, it is necessary to prepare and submit the following (40 CFR 51.12(g)):

> "(1) An analysis of the impact on air quality of projected growth and development over the 10-year period from the date of submittal.
>
> "(2) A plan to prevent any national standards from being exceeded over the 10-year period from the date of submittal. Such plan shall include, as necessary, control strategy revisions and/or other measures to ensure that projected growth and development will be compatible with maintenance of the national standards throughout such 10-year period."

This document addresses these requirements for the Denver AQMSA.

Difficulties Encountered

As this report represents one of the first efforts directed at the creation of an air quality maintenance plan, it is useful to identify and discuss some of the problems encountered. It is hoped that this will aid future efforts in this area.

This discussion is general in nature. The problem areas mentioned are felt to be those which are indigenous to such exercises.

The first phase in the preparation of an air quality maintenance plan involves the compilation, coordination, and analysis of a variety of data sources. Data problems include the lack of relevant data, discrepancies between two or more independent sources of data, and data which is deficient for one reason or another. The projection of population is one area where such problems exist. For the Joint Regional Planning Program

(JRPP) areas, Denver Regional Council of Governments (DRCOG) population projections were available for the years 1980, 1990, and 2000 at various levels of aggregation. Linear interpolation was used to calculate projections for intervening years.

Population estimates by county for all of Colorado were available from the Colorado Division of planning. While these are the official state projections, they have been completed only for the years 1975 and 1980.

Other population estimates included county planning commissions' data and OBERS data ("OBERS" is an acronym for joint economic projections by several Federal agencies). It was found that significant discrepancies exist between these two sources and the official state projections.

Travel activity data also presented some difficulty. Data on both present and projected automobile travel was supplied by the Colorado Division of Highways. Vehicle-miles traveled data is available by highway functional classification (interstate, other principal arterials, minor arterials, major collectors, minor collectors, and local streets) and by geographic area. Average speeds are provided by functional classification, but were not separately identified by geographic area. The major problem with the data is that it is given only for the year 1968 and 1990 for non-JRPP areas and for 1972 and 2000 in the case of the Denver metropolitan area. A linear interpolation was used to generate traffic activity for intervening years since there was no clear basis for any other form of interpolation.

An additional problem was the coordination of various types of data. Data is often generated for specific geographic areas (JRPP super district, AQCR boundaries, traffic zones, etc.) which are incongruous. Significant amounts of time could be saved if these deficiencies were rectified. Suggested guidelines for standardization of data, which would help to alleviate these problems in the future, include the following.

1. Input should be encouraged to be based locally and the projections (with confidence levels) should be made for the smallest possible unit.
2. There should be requirements that all planning activities (Air Quality Maintenance, water quality planning) and other infrastructures use this data to ensure comparability of projections.
3. A preferred method of automated data acquisition should be indicated.

The second phase of the development of an air quality maintenance plan involves the translation of socioeconomic data into emissions. Unfortunately there exists no perfect way for projecting area or point source emissions. For purposes of projecting point source emission rates, employment by industrial category was used. Area source emissions were projected by population and employment growth rates. In both cases linear relationships were assumed between the socioeconomic variable and the emission. Work is currently being done in this area. Volume 7 of the EPA's Guidelines for Air Quality Maintenance Planning and Analysis provides a "workbook" approach for calculating emissions using the best available data sources. Work such as this should go far in alleviating this problem area.

Phase three involves the modeling of air quality. A meaningful air quality projection procedure initially rests upon the ability to separate the contribution from different source types to air quality at a particular point. This in turn depends upon knowledge of the magnitude and distribution of point and area source emissions for a given base year. The locations and emission characteristics of point sources are usually much better known than those of area sources, whose emissions are obtained on a county-wide basis and then must be allocated. Population density was the sole allocation criterion employed by EPA in their computerized emissions gridding procedure which generated the area source emissions maps used in the study. This technique is probably valid for emissions due to home heating but would not really apply for industrial sources. Perhaps the least well understood emissions are those from fugitive dust sources. In addition to the rather obvious uncertainty in the emission factors for these sources, their allocation was based upon such criteria as agricultural land use and density of dirt roads. The most detailed knowledge of area source emissions exists for CO, HC, and NO_x emissions from mobile sources. This is the case because most urban areas have rather detailed information concerning current and projected traffic on a network of roadways which can be described in terms of a coordinate system.

Given that the strength and distribution of the various sources are well known, there still remains the problem of relating these emissions to concentrations at various points. Fortunately for area source emissions it is generally true that for primary pollutants the air quality is due primarily to local emissions. This is the basis of the rollback model used in connection with mobile source emissions. For elevated point sources the analysis of air quality contributions requires the application of an atmospheric diffusion model. The results from such a model depend strongly upon the input frequency distributions of wind speed, direction, and stability which are usually derived from measurements taken at one location in the area of study.

Once the modeling analysis has been completed there remains the task of calibrating the results with air quality measurements. For particulates, this is complicated by the need to determine the magnitude of the background contribution, which is usually considered to be about 30 $\mu g/m^3$. This background subtraction procedure still does not address the problem of the contribution of localized sources (dirt roads, traffic, etc.) in the immediate vicinity of the air sampler. This is particularly a problem for locations with air samplers situated close to the ground. This difficulty can be somewhat alleviated by carrying out a least squares fit of the calculated values to the measurements and then using the fitted values for projections and application of strategies, as was done for this report.

The extensive modeling and calibration activities provided projections of air quality for the maintenance study period, 1975-1985. Unfortunately, the data indicated that the air quality problem was not merely one of maintenance of the standards but also one of attainment; i.e., current regulations provide insufficient control to ensure meeting the National Ambient Air Quality Standards by 1975 for particulates or by 1977 for carbon monoxide and oxidants. This necessitated the consideration of additional controls and the development of contingency attainment measures.

The final steps in the plan preparation are the most important and perhaps the most difficult. While the available "tools" for attainment and maintenance are well known, the selection of the proper measures is constrained by the legal, social, economic, and political realities of the maintenance area. These constraint variables involve no small amount of uncertainty. For example, while laws exist in Colorado for both air quality and land use, their viability as far as air quality maintenance is as yet untested. Social and economic constraints involve the acceptance of the plan by the business establishment and the community in general. Uncertainties as to the total political and social acceptability of the plan are bound to arise due to the lack of communication between interested parties and agencies before the actual presentation of the plan to be adopted. The poor definition of governmental agency responsibilities also makes for increased difficulty in assigning roles for the implementation of an air quality maintenance plan.

As a way of circumventing some of these problems, careful specifications of the laws which apply, the hierarchy of the agencies involved, and inclusion of the public into the election process is necessary.

Report Contents

This document presents the information necessary for the development and evaluation of the Air Quality Maintenance Plan, as well as the plan itself.

The information is presented in a summarized form, in logical sequence, with supporting technical data and expanded discussions of methodology included in the appendices.

The subject matter covered by each of the major sections is briefly described below:

Section II - This section provides the physical, socioeconomic, and legal setting of the AQMSA.

Section III - A review of the emission allocation and projection methodologies used for determining the air quality in 1975, 1980, and 1985 is given.

Section IV - An assessment of existing and future air quality is then provided, forming the basis for the quantified approach to the formulation of the Air Quality Maintenance Plan (AQMP).

Section V - A contingency air quality attainment strategy is presented in this section.

Section VI - This last section consists of the air quality maintenance strategy for the AQMSA. Descriptions of the measures, their legal foundation (existing and proposed), and the roles of agencies involved in the strategy implementation are given. Cost estimates of the measures as well as a timetable for additional legal authority are also presented.

SECTION II

DENVER AIR QUALITY MAINTENANCE STUDY AREA REGIONAL SETTING

A fundamental requirement in development and assessment of air quality maintenance measures is a thorough understanding of the regional and urban settings to which they are to be applied. This includes a specification of the physical setting, including such features as topography, climatology, meteorology, hydrology, land use and transportation infrastructure; and socioeconomic parameters including demography, employment and residence patterns, institutional arrangements and related characteristics. It is also necessary to have an understanding of the current air quality control situation in the region: the agencies currently involved or which are to be concerned with the maintenance of air quality, the legal authority required and provided, and the degree of regulation which sources are already undergoing.

This information is summarized and presented in this section.

PHYSICAL DESCRIPTION

Identification of Study Area

Colorado is the eighth largest state. It is rectangular, about 385 miles from east to west and 275 miles from north to south, and has an area of 104.247 square miles. Roughly one-third of the State, known as the "western slope," lies west of the Continental Divide. The remaining two-thirds of the State, lying east of the Divide, is referred to as the "eastern slope." Approximately 50 mountains have peaks which reach a height of 14,000 feet or more above sea level.

The State contains seven intrastate air quality control regions (AQCR's) and a part of the Four Corners Interstate AQCR. The eight AQCR's are identified by number in Figure 1. Regions 1, 2, 3, 4, and 5 lie principally to the east of the Divide. This Air Quality Maintenance Plan is concerned with conditions within the area designated as the Metropolitan Denver AQCR (Region 2) and Larimer and Weld Counties of the Pawnee AQCR (Region 1). It includes, in addition to the City of Denver, the major urban centers of Boulder, Longmont and Broomfield in Boulder County, Fort Collins and Loveland in Larimer County, Greeley in Weld County, and Brighton in Adams County. These cities and other characteristics of the region are displayed on the maps in Figures 2 and 3.

Topography

Principal topographical features of the Denver portion of the AQMSA region are shown in Figure 4. The AQMSA extends eastward from the Continental Divide into the plains, with the major urban centers located along the foothills of the Rockies. The greater Denver area lies within the South Platte River drainage basin as shown in the figure. The City of Denver, through which the river flows, has an elevation in excess of 5000 feet. Roughly 20 miles to the west the mountains reach elevations of 10,000 to 14,000 feet; to the southwest the land rises more gradually along the South Platte River valley.

Problems in developing appropriate transportation control strategies for the AQMSA have been compounded by the high elevation of the region, since operating parameters of internal combustion engines and the effectiveness of control devices are functions of ambient air density. The influence of topography upon climatological and meteorological features

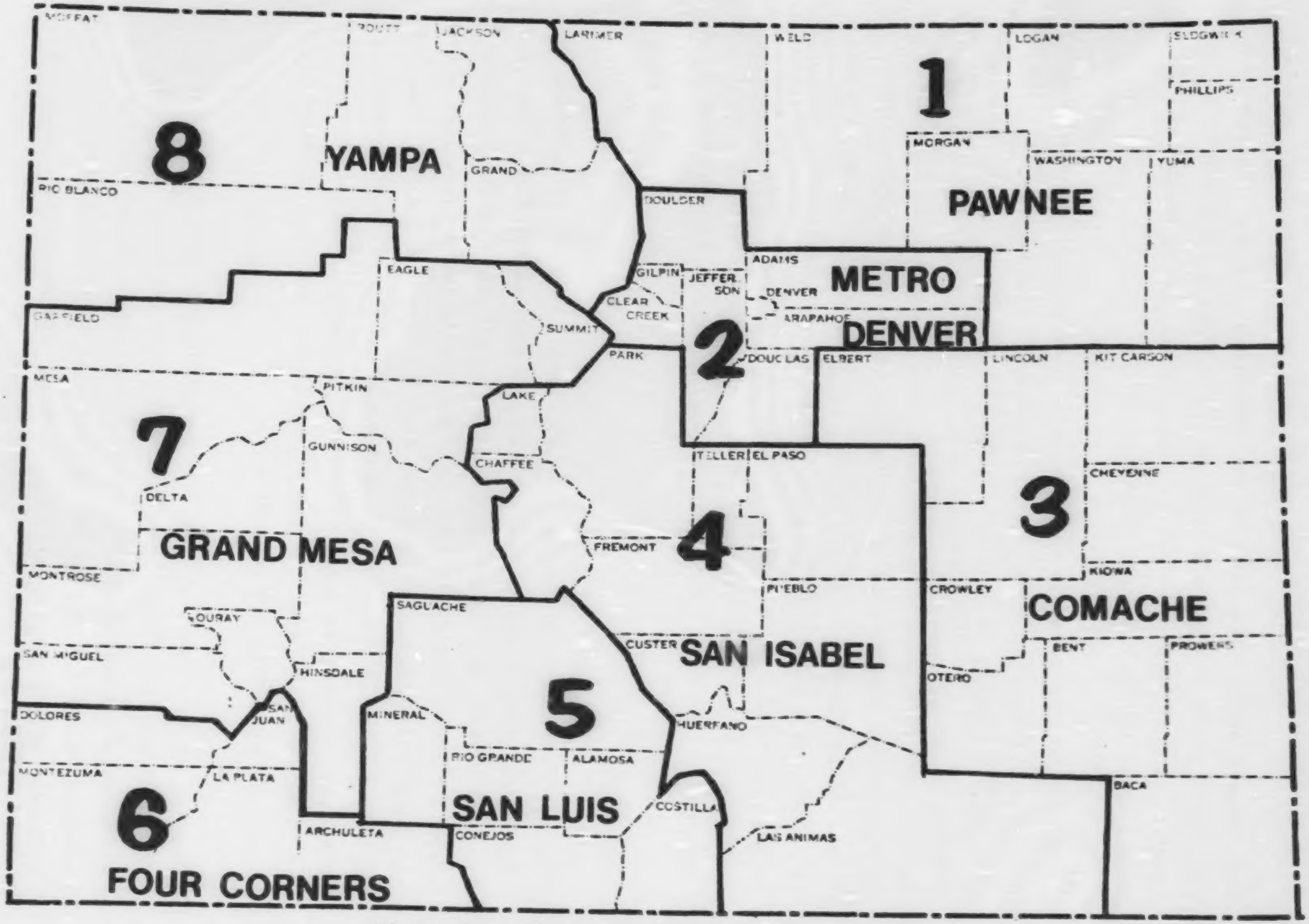

MOFFAT
ROUTT
JACKSON
LARIMER
WELD
LOGAN
SEDGWICK
1
PHILLIPS
8
YAMPA
MORGAN
GRAND
WASHINGTON
YUMA
RIO BLANCO
BOULDER
PAWNEE
ADAMS
EAGLE
GILPIN
JEFFERSON
DENVER
METRO
GARFIELD
CLEAR CREEK
ARAPAHOE
DENVER
SUMMIT
2
PARK
DOUGLAS
ELBERT
LINCOLN
KIT CARSON
MESA
PITKIN
LAKE
7
GUNNISON
TELLER
EL PASO
CHAFFEE
CHEYENNE
DELTA
3
GRAND MESA
FREMONT
4
MONTROSE
KIOWA
PUEBLO
CROWLEY
SAGUACHE
COMACHE
OURAY
SAN MIGUEL
CUSTER
SAN ISABEL
BENT
PROWERS
HINSDALE
OTERO
5
DOLORES
SAN JUAN
MINERAL
HUERFANO
RIO GRANDE
ALAMOSA
MONTEZUMA
LA PLATA
BACA
SAN LUIS
COSTILLA
6
ARCHULETA
CONEJOS
LAS ANIMAS
FOUR CORNERS

Figure 1. Colorado Air Quality Control Regions

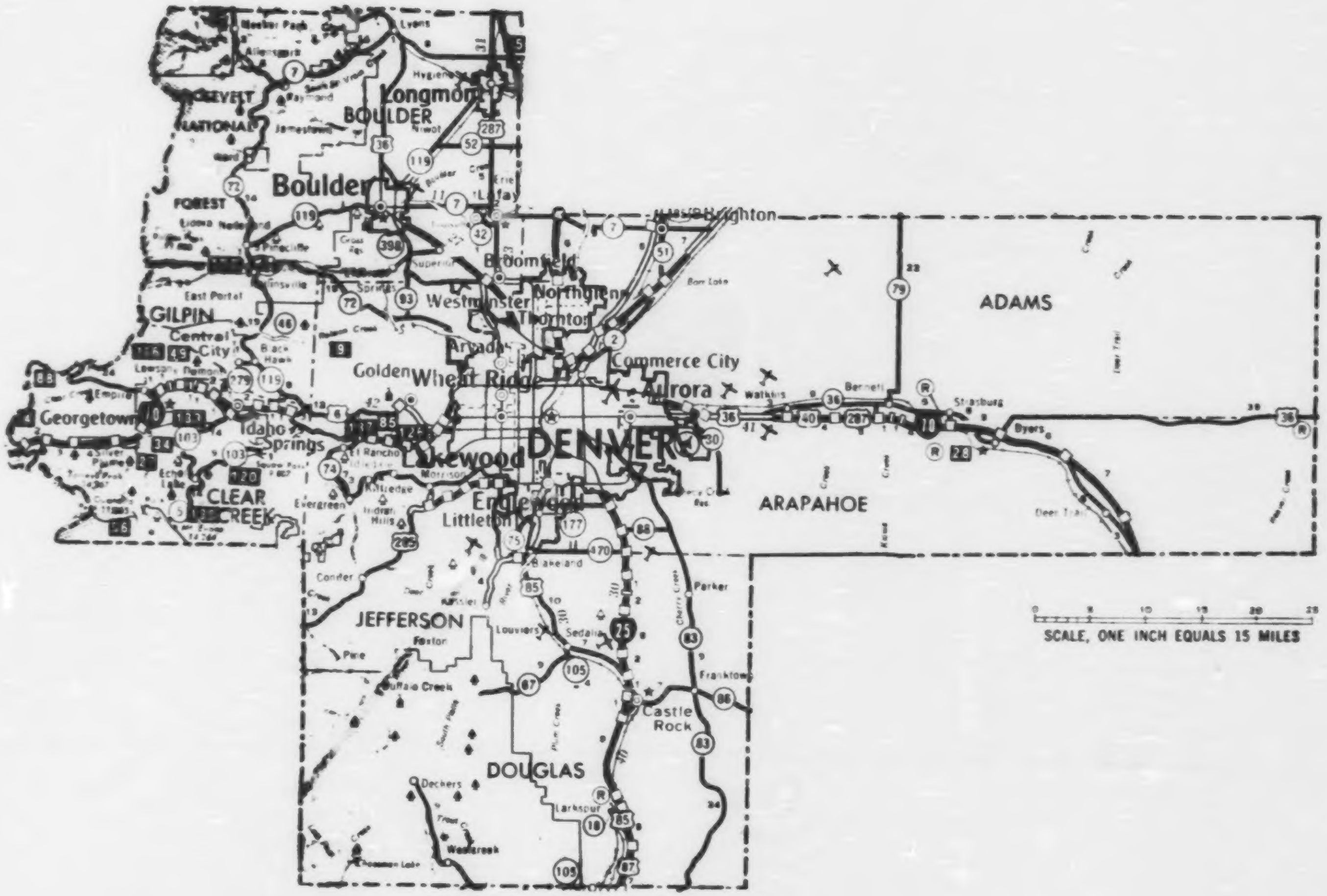

Longmont
BOULDER
Boulder
Brighton
Broomfield
Westminster
Northglenn
Thornton
Arvada
Commerce City
Golden
Wheat Ridge
Aurora
DENVER
Lakewood
Englewood
Littleton
GILPIN
Central City
Georgetown
Idaho Springs
CLEAR CREEK
ADAMS
ARAPAHOE
JEFFERSON
DOUGLAS
Castle Rock
Bennett
Strasburg
Byers
Parker
Sedalia
SCALE, ONE INCH EQUALS 15 MILES

Figure 2. Spatial characteristics of the Metropolitan Denver AQCR

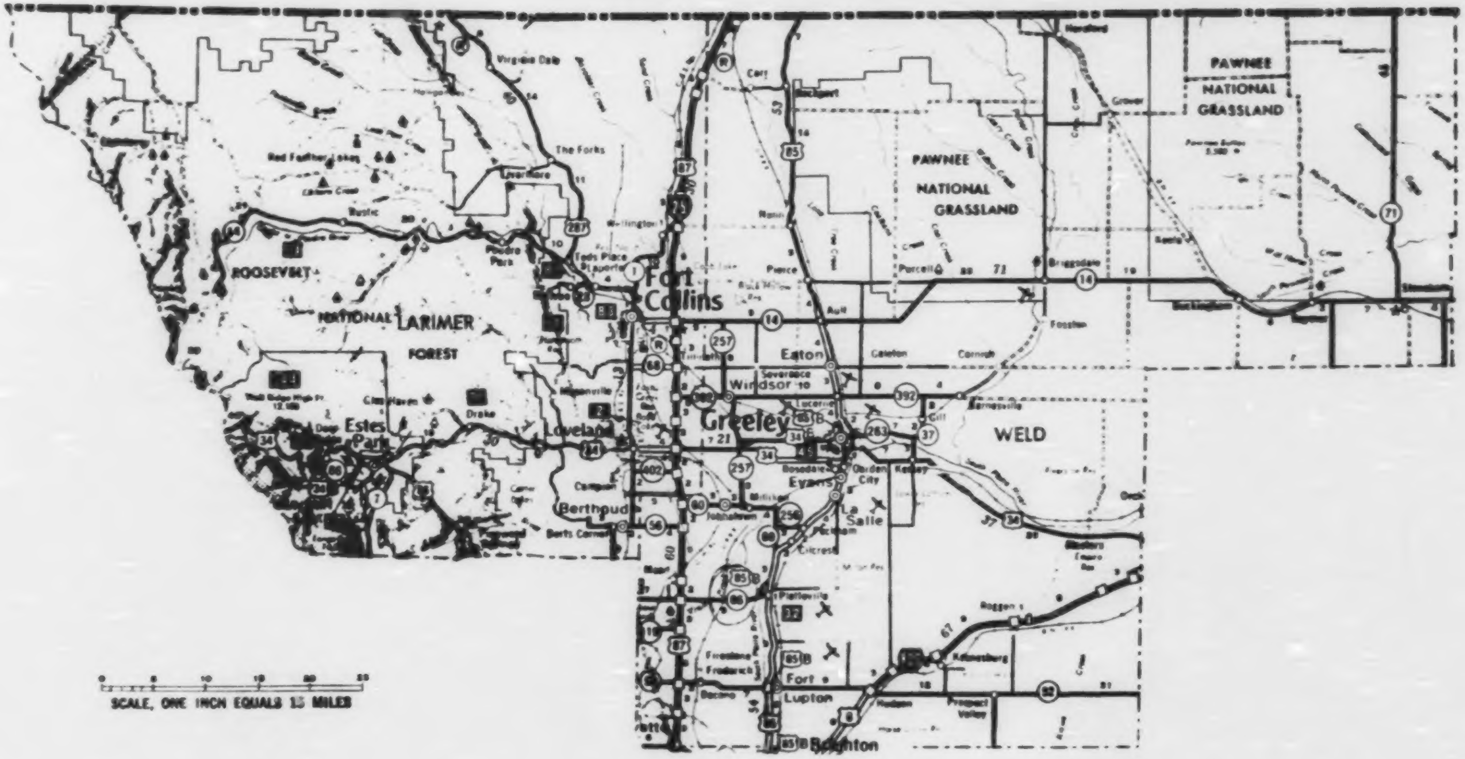

PAWNEE NATIONAL GRASSLAND
PAWNEE NATIONAL GRASSLAND
ROOSEVELT NATIONAL FOREST
LARIMER
WELD
Fort Collins
Greeley
Loveland
Estes Park
Berthoud
Windsor
Eaton
Evans
La Salle
Fort Lupton
Brighton
The Forks
Virginia Dale
Wellington
Severance
Pierce
Ault
Nunn
Grover
Briggsdale
Kersey
Platteville
Milliken
Johnstown
Drake
Gilcrest
Hudson
Keenesburg
Prospect Valley
Frederick
Firestone
Erie
Dacono
Lucerne
Garden City
Rustic
Buckingham
Stoneham
Hereford
Carr
Purcell
Gill
Galeton
Kuner
Barnesville
Roggen
Hazeltine
SCALE, ONE INCH EQUALS 15 MILES

Figure 3. Spatial characteristics of Larimer and Weld Counties.

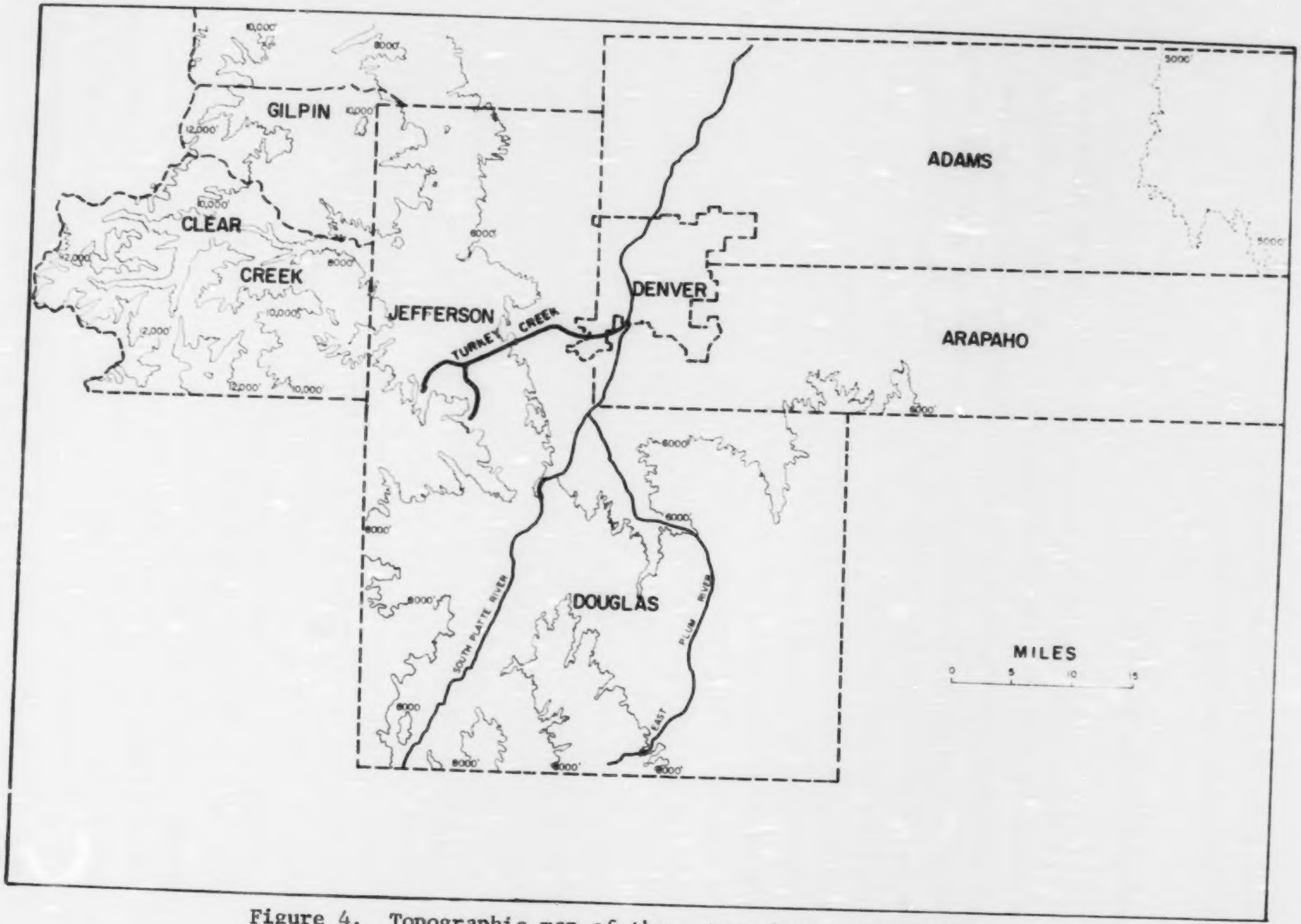

GILPIN
CLEAR
CREEK
JEFFERSON
TURKEY CREEK
DENVER
ADAMS
ARAPAHO
DOUGLAS
SOUTH PLATTE RIVER
PLUM RIVER
EAST
MILES
0
5
10
15
10,000'
12,000'
8000'
6000'
5000'

Figure 4. Topographic map of the metropolitan Denver AQCR. Major contour lines are at 2,000 foot intervals

controlling the pollution characteristics of the area is developed in the following two subsections.

Climatology of the Region

With a given set of emission sources, the degree of air pollution experienced within an urban area, including its spatial distribution and the frequency and duration of its occurrence, depends largely upon existing meteorological conditions. The principal controlling meteorological parameters are the wind speed and direction, and the vertical stability of the atmosphere within the first few hundred feet above the ground. To a large extent the wind speed governs the rate of dilution experienced by the pollutants upon emission, and the stability controls the rate at which pollutants can be mixed vertically and the thickness of the atmospheric layer through which this mixing occurs. It follows that the pollution potential for a region is greatest during periods of light winds and strong surface temperature inversions. Other parameters of importance are precipitation, which cleanses the air, and solar radiation, which initiates photochemical reactions. This section presents climatological summaries of pertinent meteorological data.

The climates of local areas of Colorado are strongly influenced by differences in terrain and elevation, and by the orientation of mountain ranges and valleys relative to general air movements. Wide variations occur within short distances. For example, the difference in annual mean temperature (35°F) between Pikes Peak and Las Animas, 90 miles to the southeast, is about the same as that between southern Florida and Iceland. As a second example, the average annual snowfall at Cumbres in the southern mountains is nearly 300 inches, while less than 30 miles away at Manassa in the San Luis Valley, snowfall averages less than 25 inches. As noted previously, the Denver AQMSA extends from the mountain areas in the west into the eastern plains. The principal areas of concern for the development of the AQMP are the population centers along the eastern foothills and, in particular, the City of Denver.

Because of Denver's location on the eastern slope of the Rocky Mountains in the belt of prevailing westerlies, the climate is generally mild and dry. The greatest amount of precipitation occurs in spring when moist air currents from the Gulf of Mexico meet weak polar outbreaks from the north. Wide local variations in wind regimes along the foothills are introduced by mountain and valley winds. Air drainage is generally good in the canyons, but as these canyons emerge onto the plains the slope is much less, and the air circulation may become very sluggish along the wider river and creek valleys, resulting in a drastically increased pollution potential. Other climatic effects of the mountains on this area are reduced temperature variations and increased precipitation as compared to those of the plains proper. Monthly climatological statistics for the City of Denver are presented in Table 1, and monthly wind direction roses, showing prevailing south and southwesterly winds throughout the year, are presented in Figure 5.

The maximum vertical depth of the atmosphere available in any day for the mixing of polluted air usually occurs in the afternoon following the period of maximum surface heating and is known as the maximum mixing height. The minimum mixing height is associated with minimum surface temperatures and usually occurs at or around sunrise. For any given wind speed, the greater the mixing height, the greater the volume of air available to dilute the pollutants and therefore to lower their concentrations. During a typical 24-hour cycle, the depth of the mixing layer in Denver varies by nearly one order of magnitude as a result of radiational cooling of the earth's surface at night and solar heating of the earth's surface during the day. The generally clear skies and low humidity of the area contributes markedly to the amplitude of this diurnal cycle. Afternoon mixing heights are least in the fall and winter and greatest in the spring and summer, ranging from a low of about 1300 meters in December to a high of about 3600 meters in May. The mean morning mixing heights range from about 175 to 450 meters, with the greatest heights again occurring in the spring and early summer. Monthly variations of the mixing heights are shown graphically in Figure 6.

Table 1. CLIMATOLOGICAL SUMMARY FOR DENVER, COLORADO (FROM THE WEATHER HANDBOOK, CONWAY PUBLICATIONS)

	Temperatures											Average number of days of									
	Average		Ex- treme				Precipi- tation		Wind							Sunup/ sundown					
	Max	Min	Max	Min	Degree days	Rel. hum.[a]	Total	Snow	mph	Dir	% Poss sun	Rain 0.01"	Snow 1.0"	Thun	Fog	clr	pc	clo	Sun- rise 15th	Sun- set 15th	% IFR
Jan	42	16	72	-24	1125	44	1	9	10	S	70	6	3	0	1	10	10	11	7:20	5:00	3
Feb	45	19	76	-30	954	45	1	8	10	S	70	6	2	b	2	8	9	11	6:53	5:36	5
Mar	51	25	80	-11	843	41	1	12	11	S	69	8	4	b	1	8	11	12	6:12	6:07	8
April	61	34	85	6	525	39	2	10	11	S	62	9	3	1	1	6	10	14	5:23	6:38	7
May	69	43	96	22	286	39	2	2	10	S	64	11	b	6	1	6	12	13	4:46	7:07	4
June	81	52	104	30	65	33	2	T	10	S	72	9	0	10	1	9	13	8	4:31	7:30	1
July	87	58	104	43	5	32	1	0	9	S	70	9	0	12	b	9	16	6	4:44	7:27	2
Aug	85	57	101	41	11	32	1	0	9	S	73	8	0	8	1	9	15	7	5:12	6:57	1
Sept	77	48	97	24	120	32	1	2	9	S	77	6	b	3	1	13	10	7	5:41	6:09	2
Oct	66	37	88	8	425	34	1	3	9	S	72	6	1	1	1	13	10	8	6:10	5:21	3
Nov	53	26	79	-8	771	39	1	8	10	S	66	5	2	b	1	11	10	9	6:44	4:45	5
Dec	45	18	74	-11	1032	41	1	6	10	S	68	4	2	0	1	11	11	9	7:14	4:36	5
Year	64	36	104	-30	6132	38	14	59	10	S	69	86	18	42	10	113	137	115	...	...	4

[a] Measured at 11 MST.

[b] Less than 1/2.

Notes:

1. T = trace, less than 1/2 inch.
2. Agricultural Weather - Average date of last freeze: May 2; Latest recorded freeze: May 28; Average date of first freeze: October 14; Earliest recorded freeze: September 18; Average freeze-free period (days): 165.

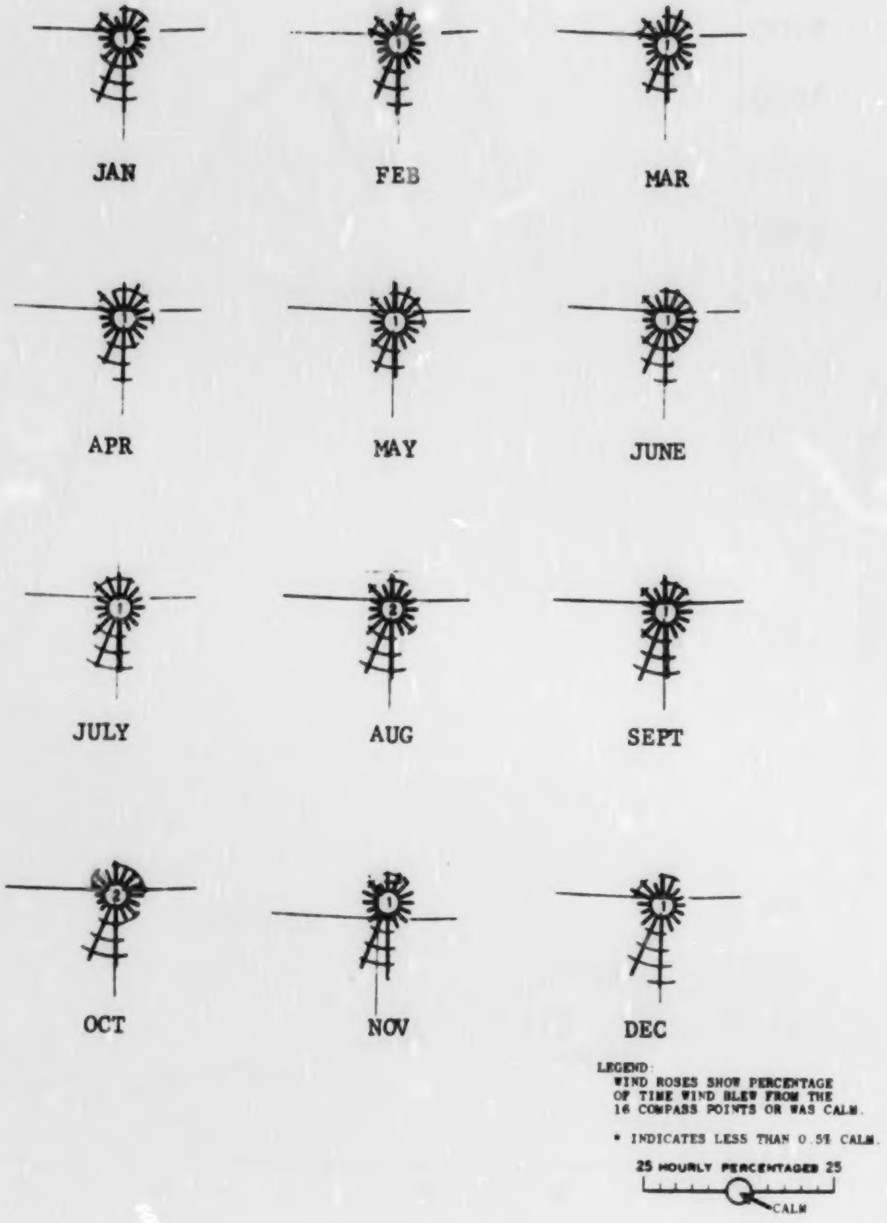


Figure 5. Monthly wind roses for Denver, Colorado

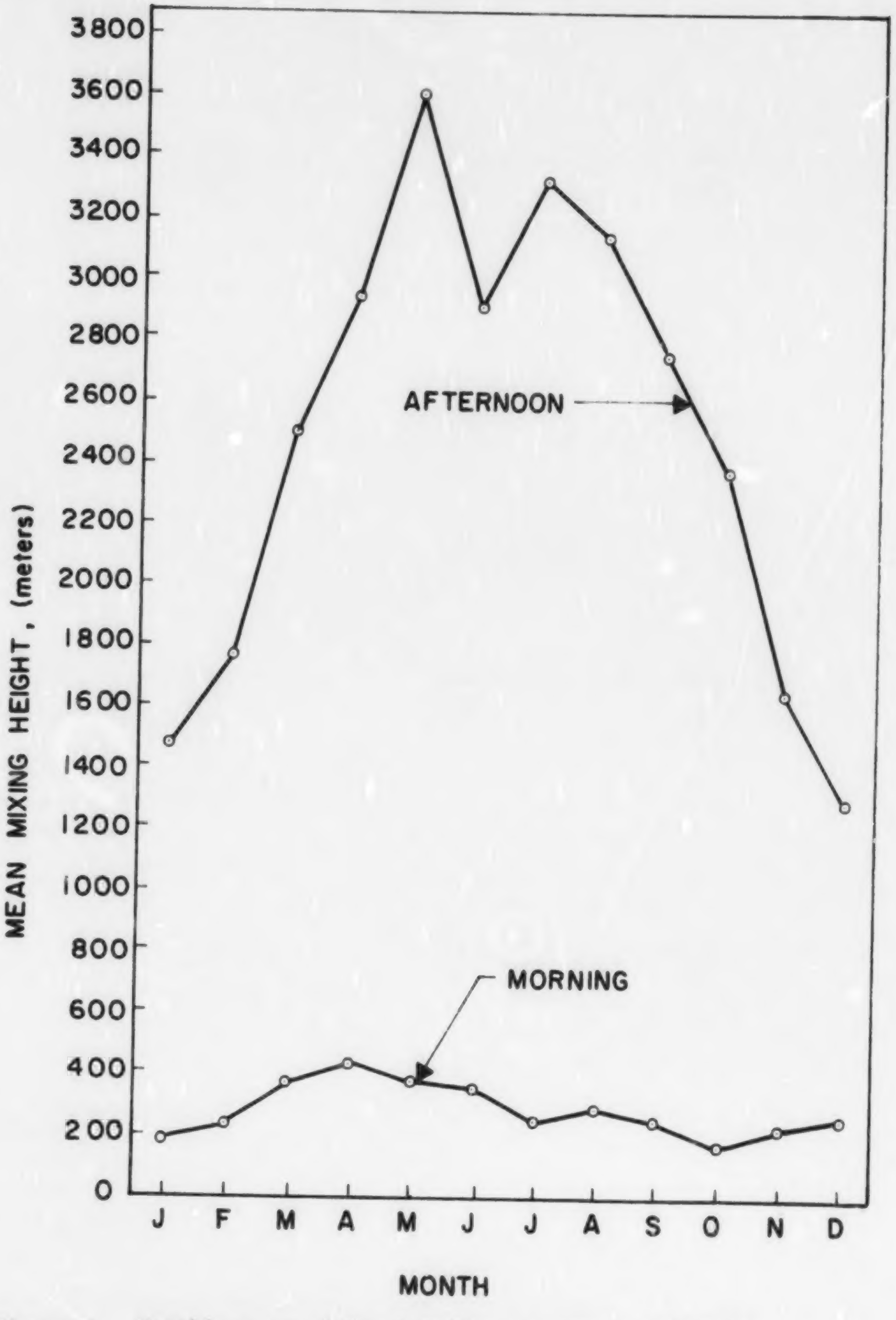


Figure 6. Monthly mean mixing heights at Denver, Colorado based on an 8-year period

An inversion layer in the atmosphere is a layer through which the temperature increases with altitude and within which vertical motions are suppressed. The inversion may be ground-based, trapping pollutants near ground level, or it may occur at some appreciable height above ground where it serves as a lid to the mixing layer. On most nights of the year in the Denver area, temperature inversions form at or near the surface; these inversions range from a few degrees to 30°F or more in extreme cases. In Table 2, the frequency of low-level inversions in Denver is given by season for four times of the day. The high frequency of early morning inversions in summer (84 percent at 5 a.m.) is not necessarily associated with high pollution levels, since daytime heating rapidly breaks up the inversion as shown by the reduction in frequency to 15 percent by 8 a.m.

Meteorology and Denver Pollution Levels

Periods of exceptionally high pollution levels in Denver have been studied in detail by Riehl and Crow (1962) and Riehl and Herkhof (1970, 1972). An understanding of local meteorological conditions giving rise to extreme pollution, and their prediction, is obviously requisite to the successful development and application of episodic control strategies. Perhaps the most important result of the initial work by Riehl and Crow was documentation of a daily wind regime that occurs over the metropolitan Denver area during light wind conditions, and the associated movement of a coherent polluted air mass.

As shown in Figure 4, the South Platte River passes through the City of Denver, flowing from southwest to northeast. Under light nighttime wind conditions surface air, made relatively more dense by radiational cooling, drains down the river valley toward the northeast and lower elevations. This cold air drainage apparently stops just beyond the suburbs and the shallow air mass, which has accumulated pollutants from city sources, is frequently brought back by a sudden wind reversal around noon. Although this change in wind direction probably reflects,

Table 2. PERCENTAGE OF FREQUENCY OF LOW-LEVEL INVERSION[a]
(STAPLETON INTERNATIONAL AIRPORT)

Season	5 p.m.	8 p.m.	5 a.m.	8 a.m.
Fall	22	78	80	49
Winter	54	82	83	75
Spring	5	58	65	22
Summer	8	54	84	15

[a] Hosler, Charles R., 1961: Low-level inversion frequency in the Contiguous United States. Monthly Weather Review, vol. 89, Sept., 1961, 319-339

in part, upslope winds produced by surface heating during the morning, the driving mechanism for the reversal is not fully understood. Under a light wind regime, crossing and re-crossing of the pollutant sources by the same air mass may continue for several days, thus leading to an excessive local accumulation of pollutants. The sketches in Figure 7, taken from Riehl and Crow, show composite wind fields prior to, during, and following such a wind reversal, and the southerly drift of the returning edge of the polluted air mass on one such day.

Figure 8a shows the diurnal variation of the concentration of total oxidants in downtown Denver averaged over two winter months and two summer months in 1972. Clearly, maximum concentrations occur during midday and during the summertime, a reflection of the part played by solar radiation in their generation. Maximum 1-hour concentrations measured during the two summer months were 0.13 and 0.18 ppm, substantially exceeding the allowable level of 0.08 ppm, while the maximum 1-hour concentrations measured during the two winter months were 0.08 and 0.03 ppm.

Figure 8b shows the diurnal variation of the concentration of carbon monoxide for selected months at the same location in downtown Denver in 1971. Although traffic data have not been plotted in this figure, it is apparent that the diurnal variation in concentration closely reflects the morning and afternoon traffic peaks in all seasons. The second feature of note is the seasonal change in average concentrations, with the highest concentrations in the winter, and the lowest concentrations in the summer. Presumably these changes result primarily from seasonal differences in the capacity of the atmosphere to disperse the pollutants, as reviewed in the previous section.

Hydrology

The Denver AQMSA lies within the South Platte River Basin. The Basin is characterized in the west by the eastern slopes of the Rocky Mountains and in the east by the plains. The South Platte River, which flows

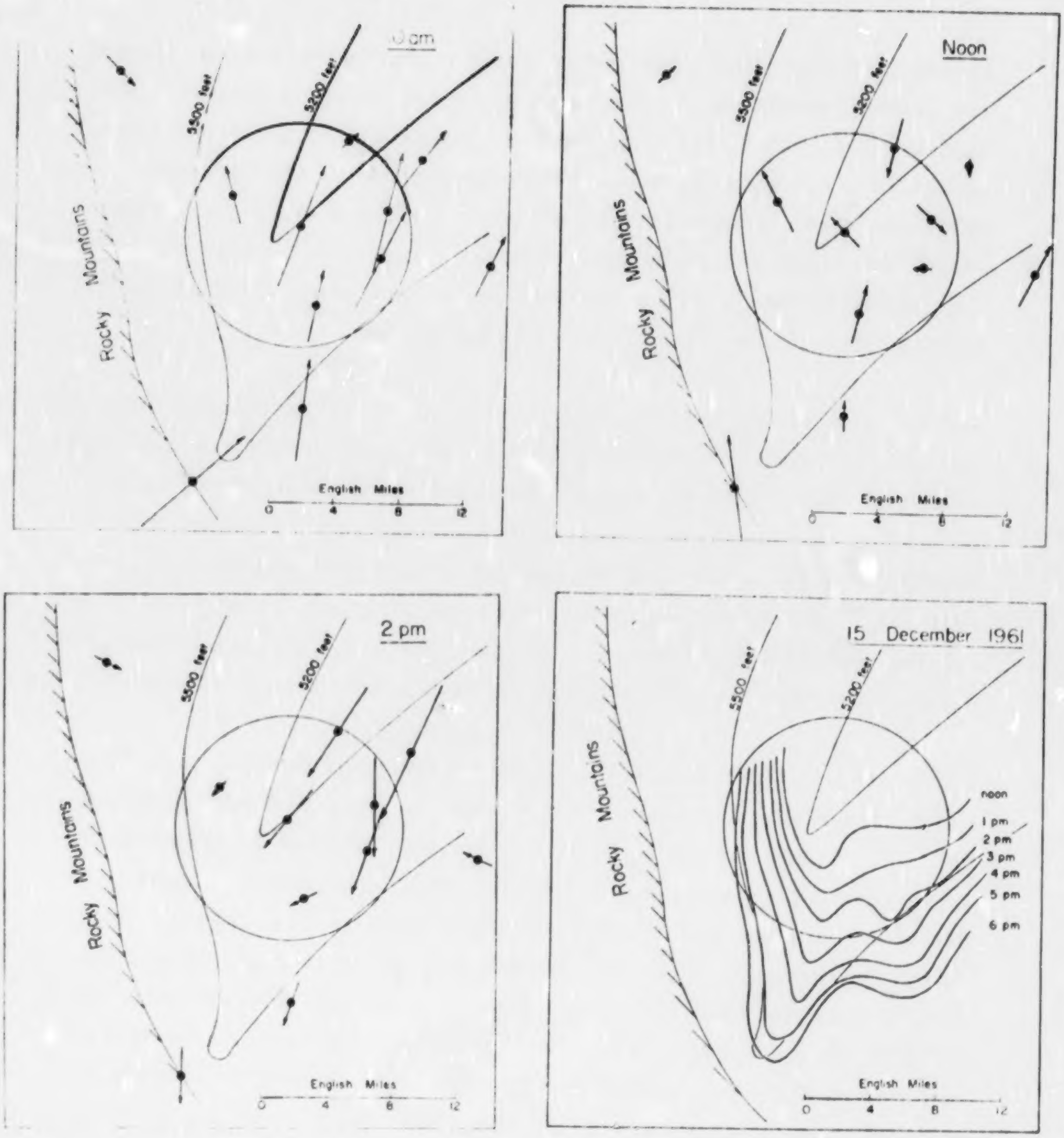
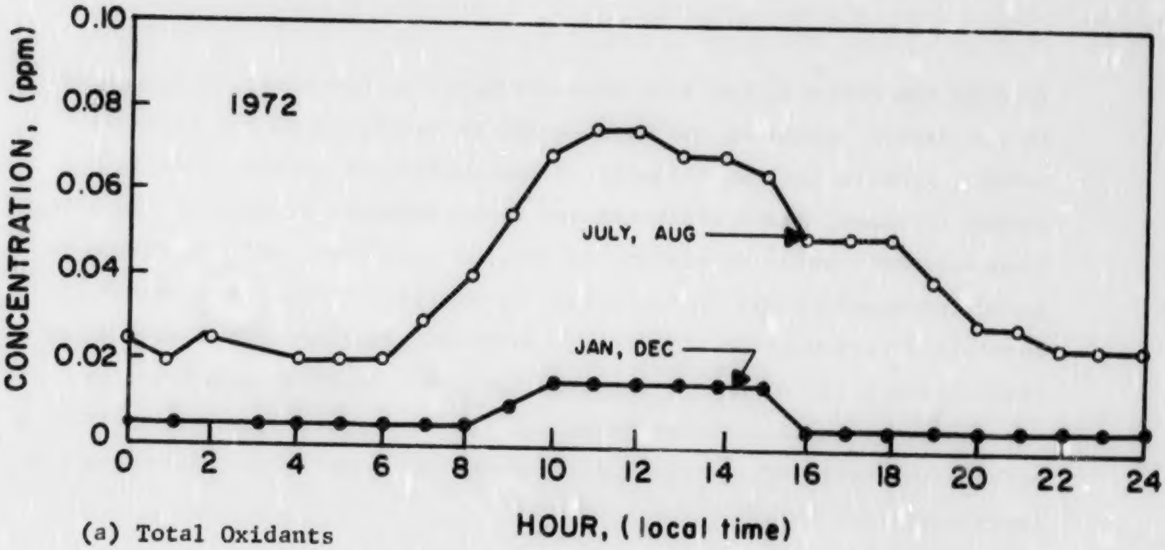
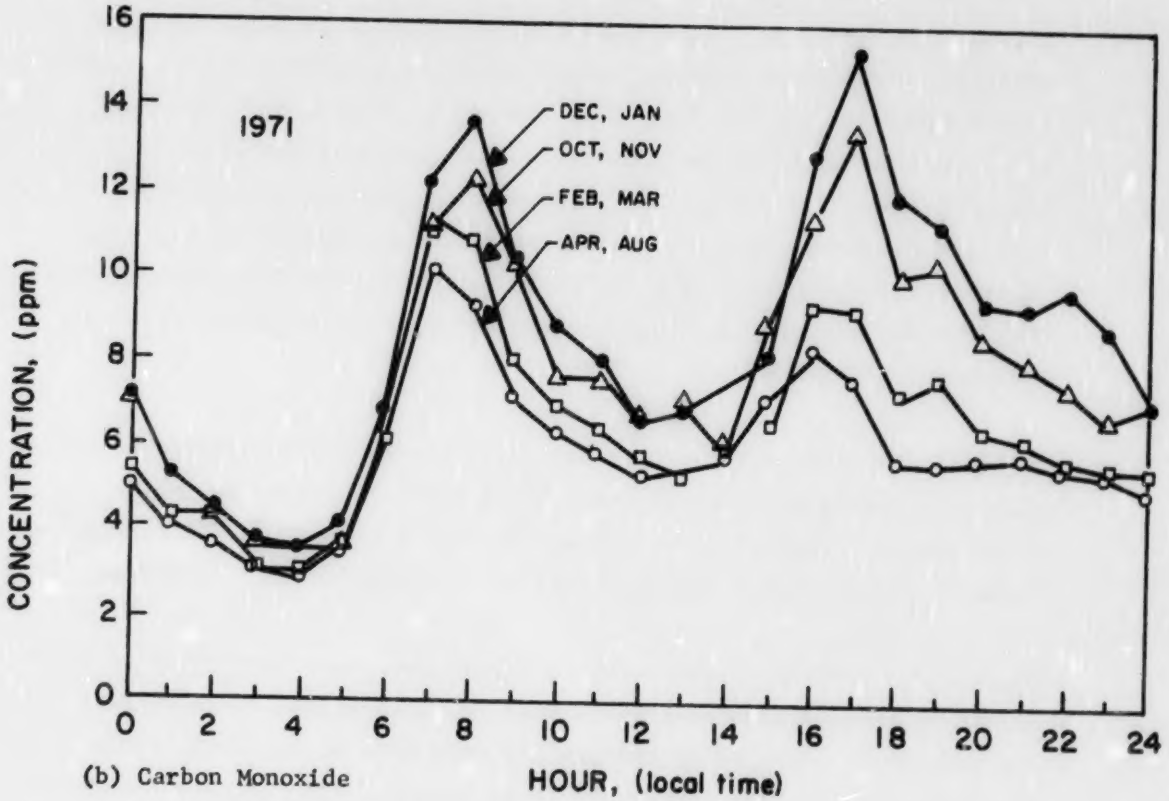

am
5500 feet
5200 feet
Rocky Mountains
English Miles
0
4
8
12
Noon
5500 feet
5200 feet
Rocky Mountains
English Miles
0
4
8
12
2 pm
5500 feet
5200 feet
Rocky Mountains
English Miles
0
4
8
12
15 December 1961
5500 feet
5200 feet
Rocky Mountains
noon
1 pm
2 pm
3 pm
4 pm
5 pm
6 pm
English Miles
0
4
8
12

Figure 7. Average wind during pollution episodes from 10 a.m. to 2 p.m. (a, b, c). Length of arrow indicates one-hour air movement. Curves in "d" indicate forward edge of polluted mass at indicated times during southward advance of polluted mass. (From Riehl and Crow, 1962)



(a) Total Oxidants



(b) Carbon Monoxide

Figure 8. Diurnal variations in total oxidants (a) and carbon monoxide (b) at the CAMP station in Denver for selected months. Plotted concentrations are for the succeeding hour period.

through the metropolitan area from southwest to northeast, originates in the eastern slope of the Rockies and is fed by snowmelt, rainfall runoff, groundwater and a number of man-controlled factors such as sewage treatment plant effluents and trans-mountain diversion. In 1970, trans-mountain water diversion was 300,500 acre-feet; this diversion is to be increased to 559,000 acre-feet by the year 2010. This trans-mountain diverted water affects the hydrology of the South Platte River Basin through its discharge into the South Platte River after its use for municipal and industrial purposes. Also, its use for lawn sprinkling affects the hydrology of the Basin through recharge of groundwater which feeds many creeks.

Although the Basin only receives an annual average of 14.8 inches of rainfall, flooding is a fairly common occurrence, with the most recent floods occurring in 1965 and 1973. Snowmelt, runoff, and rainstorms are a predominant cause of flooding. Also, urbanization within the Denver Metropolitan Area, with its resulting increase in impervious area, increases the peak and volume of floods and increases the probability of flash floods. The Chatfield Dam on the South Platte and the Cherry Creek Dam have been constructed to decrease the intensity and frequency of flooding.

Influenced by regional factors, the South Platte River experiences a wide range of flows. Sewage treatment plant effluents from Denver and a few smaller communities contribute to the flow of the South Platte and become a predominant fraction of the flow during low flow conditions.

The western portion of the Basin is tapped for water supply and in 1970 delivered 146,000 acre-feet which will increase to 223,800 acre-feet by the year 2010. Once water reaches the main stem of the South Platte, its major uses are for industrial (e.g. cooling) and irrigation purposes.

The water supply situation is such that some parts of the AQMSA are limited in growth. Water rights, some dating back over 100 years, often mean that some areas have no authority to use the water during periods of low flow. Therefore, certain sections of the AQMSA will not see major development if water rights are not available.

Land Use

The distribution of land uses in the Denver AQMSA today is the result of a large number of regional characteristics, very significant among which are the transportation network and infrastructure. Land use changes in Colorado parallel national trends, showing an increase in urban land while agricultural land has declined.

The Metropolitan Denver AQCR covers a land area of 13,067 square kilometers (5045 square miles), centered around the Denver Metropolitan Area, occupying about 712 square kilometers (275 square miles) and Denver's center city occupying approximately 5 square kilometers including a Central Business District (CBD) of 1.4 square kilometers. General land use trends for the Denver Standard Metropolitan Statistical Area (SMSA) show agricultural and vacant land being transformed to single-family residential use. Major portions of the urbanized areas in the region are characterized by single-family tract housing, strip commercial developments and a substantial freeway network. The recent decades have shown circumferential development in all directions from the Denver Metropolitan Area, served by upgraded arterials and new highways. The influence of transportation on land use choices interact through one or more of the following factors: site opportunities for development; population density; accessibility of facilities, services, employment, and community amenities; travel time requirements and costs. Generally, for the Denver region, land use patterns have developed in response to the automobile. Nevertheless, the center of Denver, near the State Capitol, creates one of several high intensity development areas within the City. Others are focused on universities, Federal employment areas, and shopping districts. The major characteristic of the region, however, is its low growth density and dispersed development pattern. Current land use patterns, therefore, result in a wide spatial separation between home, employment, schools, shopping areas, recreational facilities and other activities. At the present time the automobile dominates as a flexible and speedy method of personal transportation to meet trip requirements of the residents.

A recent inventory of zoning in the Denver SMSA shows 19 percent or nearly one-fifth of the land zoned for residential use. Although 61 percent of the land in the region is still zoned for agriculture, the trend is for rezoning to higher use (residential, commercial, industrial, and recreational). Figure 9 illustrates the existing and projected change in various economic activities for the Denver region.

The distribution of land uses in the Denver CBD and urbanized regions of the study area reflects the governmental, financial, service, and distribution functions that the urban centers perform for the metropolitan area and the larger Rocky Mountain region. Downtown Denver is not a manufacturing center, but rather the keystone of business and government, devoted to the distribution and exchange of goods, money and ideas. In decreasing order of importance, office space, hotels and motels, retail activity, and governmental facilities are the primary land uses in the Denver CBD, followed by residential, storage, commercial services, and industrial uses.

For the Denver SMSA, as a whole, commercial and industrial land uses have developed in a dispersion pattern around the urban centers. Commercial growth is mainly attributable to the development of various

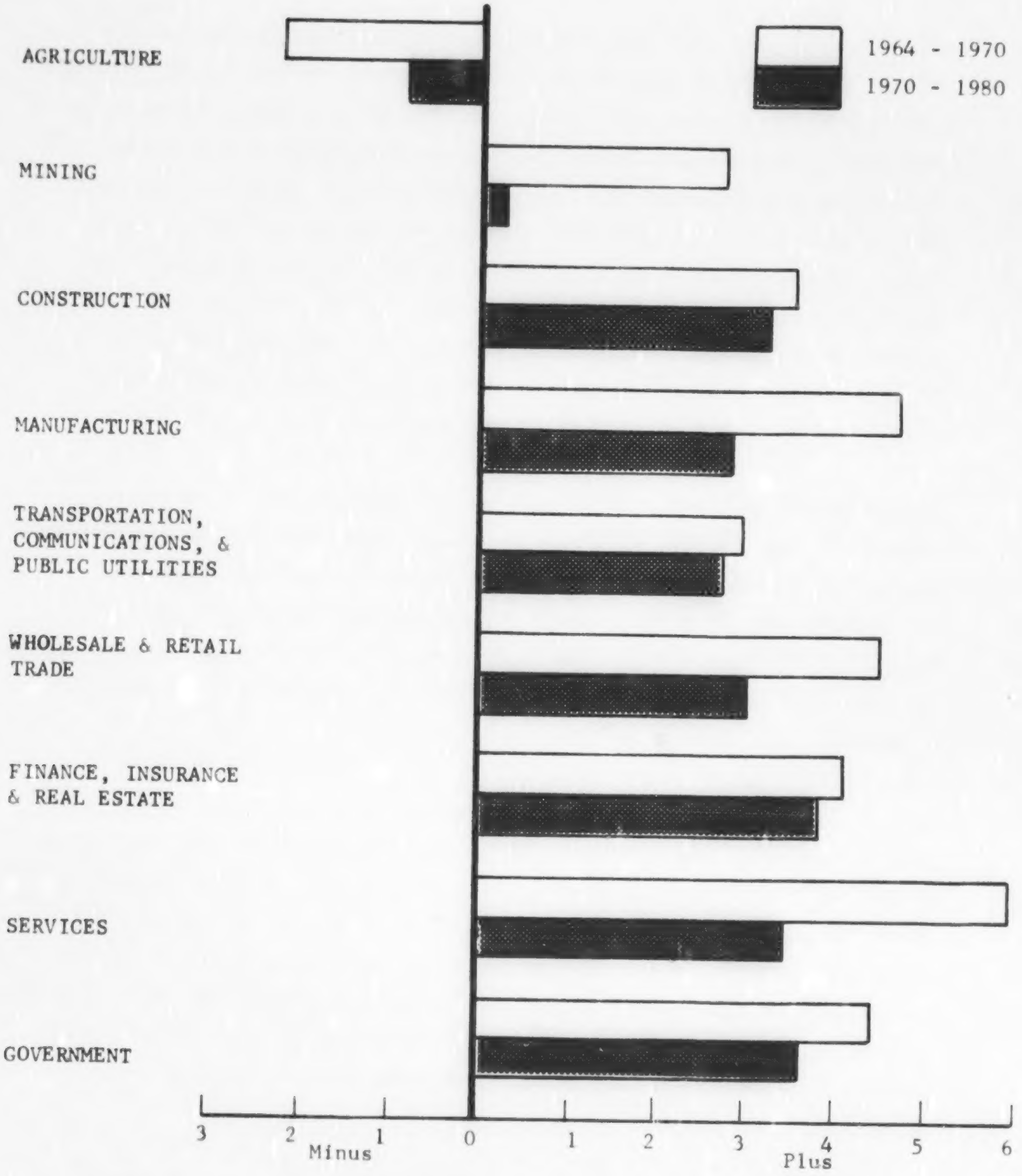


Figure 9. Annual growth rates for economic activity showing land use development potential, Denver region*

*Source: Denver Region Council of Governments neighborhood and regional shopping centers. There has been a continued dispersion of new industrial development, while diverse changes are evident in the services, parks and public land uses. New development and growth potential will depend upon available vacant space, transportation accessibility, costs, availability of water resources and related factors. Land use planning and zoning activities have varied in the region's areas. Denver and Aurora, for example, have aggressive annexation policies and promote higher use development of vacant lands through their zoning regulations. Figures 10 and 11 illustrate the 1970 and projected 1980 land use development densities, thereby mapping the pattern of change and areas with growth potential.

The land use in Larimer and Weld counties is principally cropland, rangeland, and woodland. Centered in these two counties is the Poudre Triangle, comprising about 8% of the total area of 18,021 square kilometers (6,957 square miles) yet containing the major cities of Fort Collins, Loveland, and Greeley. Even within this more urbanized region, only a small portion of the land is assigned to residential, commercial, or industrial uses.

Of the 1,334 square kilometers (515 square miles) surveyed in the Poudre Triangle for determination of land use in 1970, seven categories accounted for 96 percent of the total study area. These included ungated farming, dry-farming, pasture and grazing, vacant land, single-family residential areas, water surfaces, and educational land. Of these, the overwhelming single class is irrigated farming which comprised two-thirds of all the land surveyed. Total residential land was 4.2 percent, commercial-institutional land comprised 0.5 percent, and industrial land was 0.7 percent.

Two important controls on future development in this area currently exist: zoning and water supply. Most of the mountain region and the very northern portion of the flatland region in Larimer county is zoned

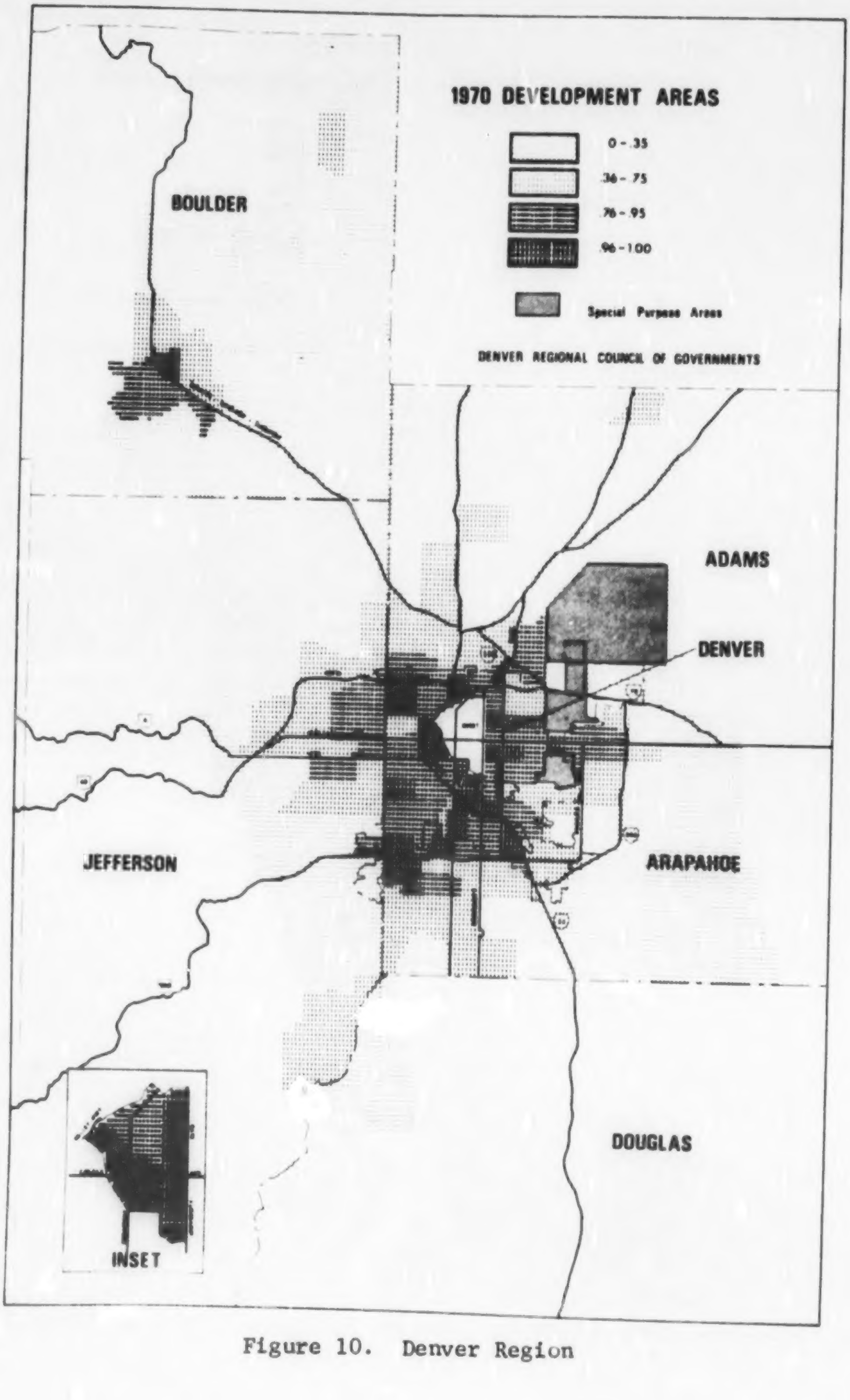

1970 DEVELOPMENT AREAS
0 - .35
.36 - .75
.76 - .95
.96 - 1.00
Special Purpose Areas
DENVER REGIONAL COUNCIL OF GOVERNMENTS
BOULDER
ADAMS
DENVER
JEFFERSON
ARAPAHOE
DOUGLAS
INSET

Figure 10. Denver Region

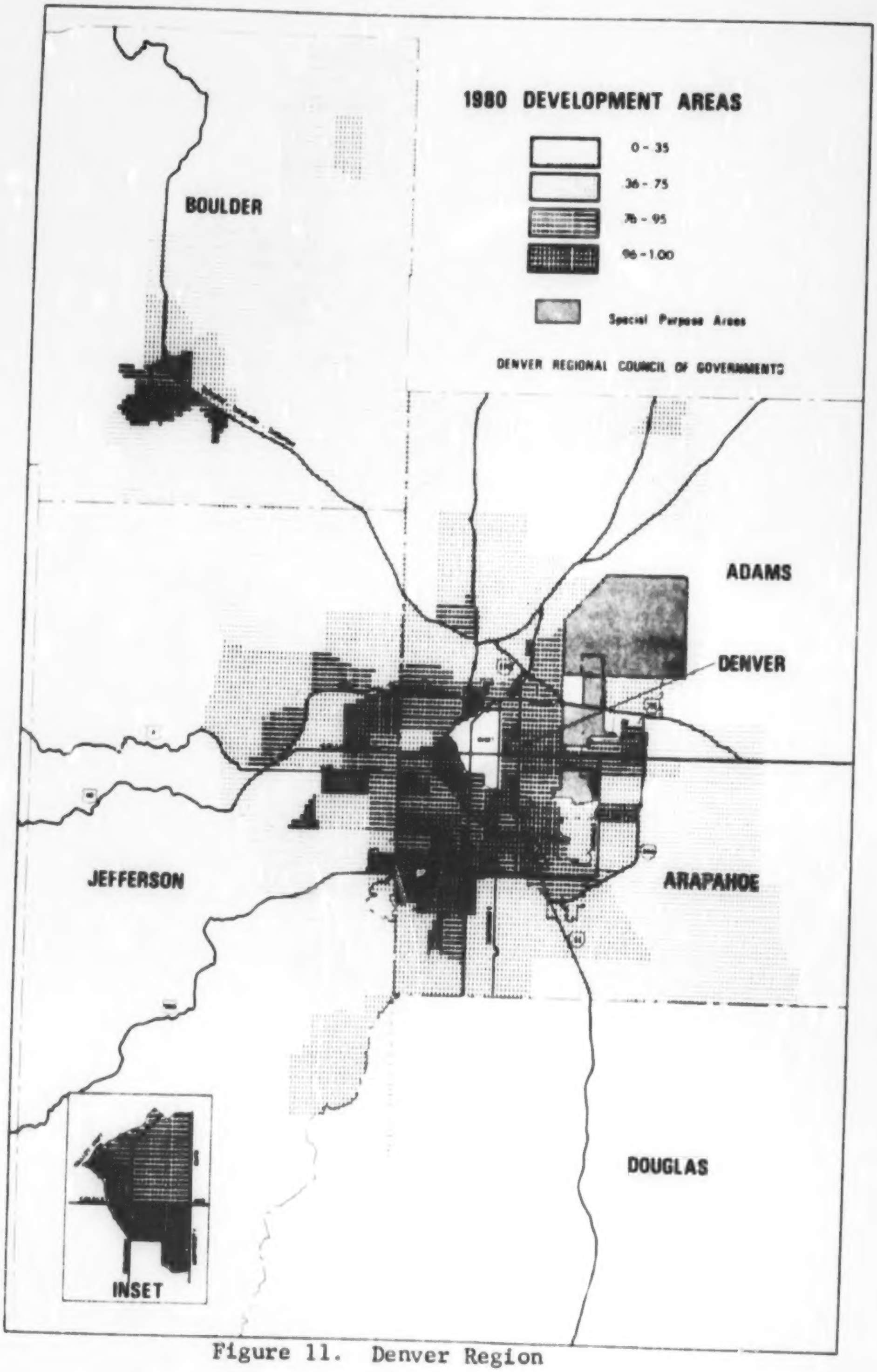

1980 DEVELOPMENT AREAS
0 - 35
36 - 75
76 - 95
96 - 1.00
Special Purpose Areas
DENVER REGIONAL COUNCIL OF GOVERNMENTS
BOULDER
ADAMS
DENVER
JEFFERSON
ARAPAHOE
DOUGLAS
INSET

Figure 11. Denver Region

O-Open; i.e., the minimum lot size is ten acres. In addition, any developer must show that he has enough water rights to, at least legally, provide the amount of water that will be needed. In the near term, it is expected that industrial and residential development will continue to take place on the periphery of the cities and towns in the area.

Transportation Infrastructure and Use

Most of the pollutants under investigation for the AQMP are a result of motor vehicle emissions. At present in the Denver AQMSA, the automobile is the dominant mode of travel. A history of automobile dominance in the region has been accompanied by the construction of a large highway system comprised of urban freeways and major arteries traversing the region. Current land use patterns exhibit a wide separation between activity centers - residences, employment, commercial facilities, recreational activities, schools, etc. - requiring a flexible transport to meet trip requirements.

Summarizing the transportation facilities and public utilities, the Denver SMSA is served by eleven major highways, five major railroads, and eleven interstate airlines. The area also encompases six airports for general aviation, and one military airport. Numerous interstate and intrastate bus lines serve the area. A regional public mass transportation system is currently being designed for the Denver region.

The Denver metropolitan area is characterized by a high growth rate of motor vehicles (5.2 percent per year) and the highest per capita automobile registration in the nation, one automobile for every 1.5 persons. On an average day in 1972 approximately 15 million vehicle-miles of travel were produced in the Denver urbanized area. The Colorado Highway Department estimates this figure will increase to 18 million VMT per day by 1980.

Within the County of Denver, comprising the core of the metropolitan area, there are approximately 1631 miles of streets operated by the State and local governments. Based on data supplied by the Transportation Division of the Denver Department of Public Works, the specific pattern of highways and operational responsibility are as follows:

- 33.6 miles of freeways
  - 32.9 miles under State control
  - .7 miles under City control
- 253.8 miles of arterials
  - 70.7 miles under State control
  - 183.0 miles under City control
- 252.7 miles of collector streets
  - All under City control
- 1631 total miles of highway in the City and County of Denver.

For the Denver region, several statistics may be employed to characterize the current demand for motor vehicle-based travel, and the stock of vehicles present to meet this need:

- Regional population
  - Denver SMSA (1970): 1,227,529
  - Denver SMSA (1973): 1,416,800
- Number of licensed drivers (1970): 767,000
- Number of passenger vehicles (1972): (automobiles, taxis, etc.)
  - Denver SMSA: 740,160
  - Denver AQCR: 751,256
- Number of trucks and buses (1972):
  - Denver SMSA: 157,837
  - Denver AQCR: 161,408

- Total number of motor vehicles (1972):
  - Denver SMSA: 933,306 (including motorcycles)
  - Denver AQCR: 949,602 (including motorcycles)

Various transportation studies have been conducted in the Denver metropolitan area to provide data input for a comprehensive Joint Regional Planning Program (JRPP) involving the Colorado Division of Highways, the Denver Region Council of Governments, and the Regional Transportation District. The JRPP was formed to develop and maintain a land development and transportation planning process for the Denver region. Trip generation, origin-destination patterns, automobile occupancy rates, and related data have been tabulated to supply input in the transportation planning process for all modes of travel. For the Denver metropolitan area, studies by the Colorado Highway Division reveal:

- Over 3,306,000 person trips are made each day
- These are made in 2,225,000 auto trips with an average car occupancy of 1.6 persons per vehicle trip
- Additionally there are approximately 217,000 truck trips used for business and cargo and 122,000 light trips used for private reasons.

Further details on the origin-destination analysis conducted by the Colorado Division of Highways related to the distribution of private vehicle trips by purpose and automobile occupancy are provided in Table 3.

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* Data based on State of Colorado, Motor Vehicle Division, Registration and Receipts Records, January 1, 1972 to December 31, 1972.

Table 3. *MOTOR VEHICLE USAGE IN THE DENVER METROPOLITAN* AREA: DISTRIBUTION OF TRIPS BY PURPOSE, AND AUTOMOBILE OCCUPANCY

Trip purpose	Percent of total trips	Automobile occupancy (persons per car)
Home based work trips	21.3	1.1
Home based shopping trips	11.5	1.8
Home based personal business trips	10.0	1.6
Home based recreation trips	9.6	2.1
Home based passenger service trips	9.3	2.1
Truck trips (business and cargo)	8.9	-
Non-home based trips	24.0	-
Trips leaving the area	3.6	-
Other[a]	1.8	-

[a] School trips and other minor trip purposes made up the remainder of reasons for travel.

Bus transit, the primary intra-region mass transit service in the Denver region, is now only used by a small portion of the region's population. Estimates range from 2-5 percent of all trips in the Denver region are presently accounted for by the bus system. A number of both public and private bus lines operate in the Denver AQMSA, with the largest system being the Denver Metro Transit (DMT) operated by the City and County of Denver. In 1971, DMT consisted of 214 buses while today 242 vehicles are operated during peak demand periods.

Since the City and County of Denver began public operation of the bus transit system in 1971, ridership has steadily increased, as shown in Table 4. For the entire County region, DMT satisfies about 75,000 of the estimated 3.3 million daily person trips, but in the Denver CBD the bus system carries a significant portion of all trips. DMT reports estimate that more than one-fifth of all CBD-oriented work trips

Table 4. ANNUAL TRANSIT PASSENGERS IN THE DENVER METROPOLITAN AREA 1969-74[a]

Year	Annual passengers	Percent charge over previous year
1969	17,951,747	-
1970	16,264,598	-9.4
1971	15,784,945	-3.0
1972	19,174,161	21.4
1973 (estimated)	22,000,000	14.7 (estimated)
1974 (estimated)	24,000,000	9.1 (estimated)

[a] Source: Denver Metro Transit

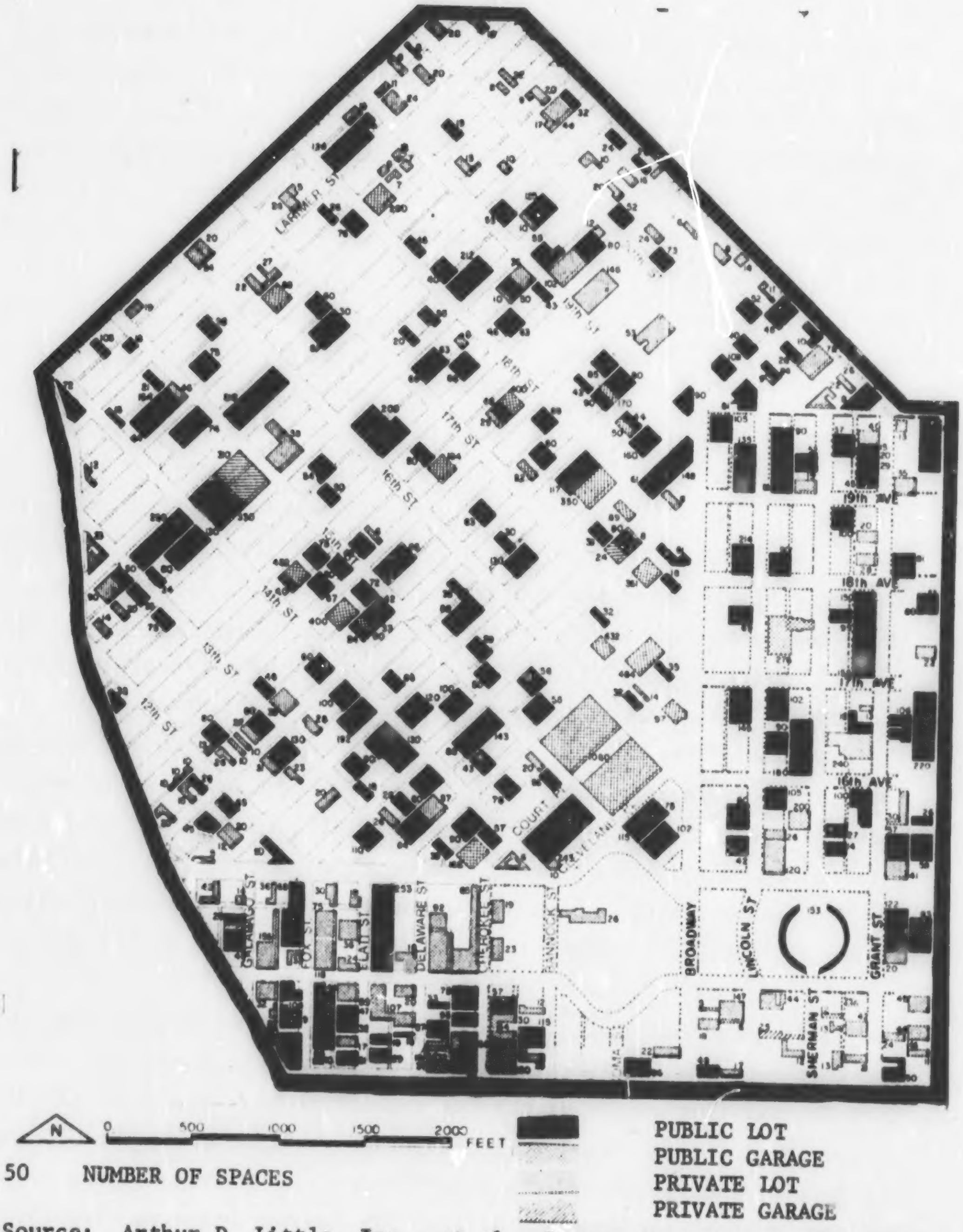
are carried on the public transit system. Thus the public takeover and operation of the bus system in 1971 has resulted in a reversal of the decline in bus ridership that had been occurring in the previous decade, and DMT officials estimate that the bus system is absorbing the equivalent of 50 percent of all new Denver CBD-oriented work trips. Further evidence of transportation system change in the Denver region affecting future patterns of travel, modal mix, and environmental impacts is evidenced by the public acceptance of a greatly expanded public transit system for the region as proposed by the Regional Transportation District.

In 1969 the State of Colorado created legislation establishing a Regional Transportation District, charged with developing long range highway and mass transit plans for transportation to serve the seven-county Denver region. A regional transportation plan was subsequently developed for the seven-county District (Denver, Adams, Arapahoe, Douglas, Jefferson, Boulder and Weld). The proposed system consists of a coordinated combination of several kinds of public transit throughout the region, including a Personal Rapid Transit (PRT) rail system, local bus, express bus, and regional bus service. Public acceptance of the proposed RTD $1.06 billion plan was demonstrated on 7 September 1973, in a public referendum approving a sales tax to finance the plan.

The two primary elements of the RTD transit plan include an "Early Action Program" (EAP) interim component and a 100-mile network of guideway "Personal Rapid Transit" routes in the most heavily traveled areas of Denver, Boulder and Greeley to be completed by 1984. The Early Action Program, relying on bus service, is planned to provide improved transit service at the earliest possible date following the successful 7 September referendum, by adding new routes and increasing the frequency on existing routes. In addition to acquiring the existing Denver Metro Transit bus system, 115 new buses will be purchased. The EAP is proposed to provide an increase of about 270 route miles within the district, representing an increase of about 60 percent in bus service. Daily bus miles will increase by some 33 percent, to about 32,000 miles. The RTD plan recognizes the interrelationships of the various modes of travel in the region and the continued importance of the automobile as an important means of access to public transportation. Analysis and development of region wide parking facilities to serve at convenient auto-intercepts and peripheral locations to the central business areas are integral components of the approved public transportation plan.

With the private automobile as the dominant mode of travel, parking facilities have been an important part in the total Denver CBD land use pattern as shown in Figure 12. In general, the availability of parking plays a significant role in travel patterns and travel modes, particularly in highly developed employment and commercial centers. In a 1970 study conducted in the Denver CBD, titled Denver Center City Transportation Project (DCCTP), it was estimated that 17 percent, or approximately one-fifth, of the total square footage of all land in the CBD was devoted to off-street parking spaces. A complete parking inventory contained in this report is provided in Table 5. In more recent inventory counts of parking in the CBD, the Denver Planning Offices estimate a total of 30,043 spaces in off-street facilities exist and the Denver Highway Division places the count of on-street metered spaces at 3800, for a total of 33,843 spaces available to the public.

The Denver Planning Office, in a draft report titled Parking Availability Within the Central Business District and Peripheral Areas, concludes that the existing supply of parking appears to be adequate as to both amount and location. Some deficiencies, however, are noted regarding the type of facilities and the rate structure as related to the availability of short-term parking spaces. The Denver Planning Office draft report, the DCCTR and other recent assessments concur that the existing adequacy and future parking supply needs are strongly dependent upon



LARIMER ST
19th ST
18th ST
17th ST
16th ST
15th ST
14th ST
13th ST
12th ST
COURT
CLEVELAND
19th AVE
18th AVE
17th AVE
16th AVE
BROADWAY
LINCOLN ST
SHERMAN ST
GRANT ST
FOX ST
DELAWARE ST
CHEROKEE ST
N
0
500
1000
1500
2000
FEET
PUBLIC LOT
PUBLIC GARAGE
PRIVATE LOT
PRIVATE GARAGE
50 NUMBER OF SPACES

Source: Arthur D. Little, Inc., et al., Denver Center City Transportation Project, September 1970

Figure 12. Off-street parking inventory in the Denver Central Business District, January 1970

Table 5. PARKING INVENTORY AND USAGE IN THE DENVER CBD, AVERAGE WEEKDAY, JANUARY 1970[a]

Type of Parking	Number of Spaces	Peak Accumulation		10:00 a.m. - 6:00 p.m.	
		Number	% of Capacity	Total Outbound	Turnover
Private Off-street	4,605	3,680	79.9	5,530	1.20
Public Off-street	20,856	17,898	85.8	20,670	0.99
Curb	3,168	2,625	82.9	16,800	5.30
Total	28,629	24,203	84.5	43,000	1.50

[a] Source: Arthur D. Little, Inc., et al., Denver Center City Transportation Project, prepared for the U.S. Department of Transportation, September 1970.

the expansion and success of the public transit system. Improved public transit both reduces future parking supply needs in the CBD, and may alter the spatial pattern of need, and the proportion of short and long term parking available to the public.

In summary, this review of the existing transportation system and short term development trends has outlined the stock of private vehicles, modal mix, travel patterns, highway networks, public transit system evolution and development plans, and availability of support facilities, such as parking, in the Denver metropolitan area. These factors interact in directing the pattern of transport use and in shaping the magnitude of travel demand in the Denver region. Identification of these various transportation system components is crucial in blueprinting transportation control measures designed to maintain air quality in the Denver AQMSA, and in evaluating control measure trade-offs, community impacts, potential adjustment patterns that may be induced, and alternative implementation procedures that may be effectively employed.

SOCIOECONOMIC DESCRIPTION

Transportation control and land use plan measures are designed to reduce overall air pollution emissions, thereby enabling the attainment and maintenance of regional ambient air quality protection of human health and welfare. Socioeconomic characteristics in regions requiring air quality maintenance plans provide important criteria in evaluating the potential effectiveness and applicability of control measures, and in selection of measures for final plan development. In addition, these community social, economic, institutional and related patterns play a dominant role in developing pragmatic procedures for control plan implementation, and in the continual monitoring of the cross section of direct and indirect impacts produced by the regulatory actions over time.

Socioeconomic data for the Denver AQMSA are presented at this stage to provide a basis for assessing the magnitude and distribution of potential impacts emanating from the control plan. This involves a performance impact evaluation of the control plan actions on air quality improvement, and assessment of the broader set of social and economic community impacts that occur irrespective of intended impacts on air quality.

In obtaining the primary air pollution reduction objective, some control measures act directly to reduce vehicular and stationary source emissions, while other control measures are designed to alter community behavior patterns, institutional arrangements and lifestyles that in turn contribute to air pollution emission reductions. (Transportation control measures designed to reduce VMT are primarily dependent for their success upon favorable behavioral modifications, which in turn are dependent upon a sound understanding of community socioeconomic conditions and trends.)

From a broader perspective the socioeconomic data compiled on the Denver region is needed to evaluate unintended impacts of maintenance measures proposed for the Denver AQMSA. These potential impacts may be classified as follows:

- Primary impacts: Social, economic and institution effects resulting from the outlay of physical and human resources in control measure implementation.
- Secondary impacts: Social, economic and institutional effects stemming from or induced by the control measures, i.e., adjustments made in response to the regulatory actions.

A broad environmental impact assessment, therefore, identifies the magnitude and distribution of social costs associated with the proposed regulatory action and provides input criteria for developing implementation procedures to attain air quality control objectives, minimize undesirable impacts and promote an equitable distribution of costs among control plan beneficiaries and pollutant emission sources.

This subsection contains a cross-sectional analysis of the following socioeconomic conditions that are either directly or indirectly affected by, and in turn affect the development of a feasible Air Quality Maintenance Plan for the Denver AQMSA: population size and spatial distribution, housing, employment, income, transit dependence, political structure and related demographic features.

Population

Colorado is ranked as the nation's fifth fastest growing State, with a statewide population increase of 25.8 percent in the 1960-1970 decade (annual growth of 2.3 percent). The Denver region's population has grown at a faster pace in the past three decades, ranging from 3 to 4.6 percent per year, with over one-half of Colorado's total population residing in the five county Denver SMSA. The Denver SMSA, encompassing Adams, Arapahoe, Boulder, Denver and Jefferson Counties, had a 1970 population of 1,227,529. Based on population gains through mid-1973, the Denver Regional Council of Governments (DRCOG) estimates the current SMSA population to be approximately 1,416,800.

Denver County contained over 50 percent of the total metropolitan Denver population in 1960, but it is estimated that by the year 2000 it will only retain about 25 percent of the total. Population is decreasing in the central city as urban sprawl moves to the north and south along the front range (Figure 13). The suburban communities accounted for approximately 80 percent of the area's population increase between 1950 and 1970. Based on estimates of the Colorado State Planning Office, Figure 14 shows the proportion of the Colorado population increase expected to be attributable to the Denver Metropolitan area and the Colorado Front Range Corridor east of the Rocky Mountains from Wyoming to New Mexico through the year 2000. While the Front Range area and metropolitan Denver are projected to experience explosive growth, the rest of the State's population may stabilize or decline.

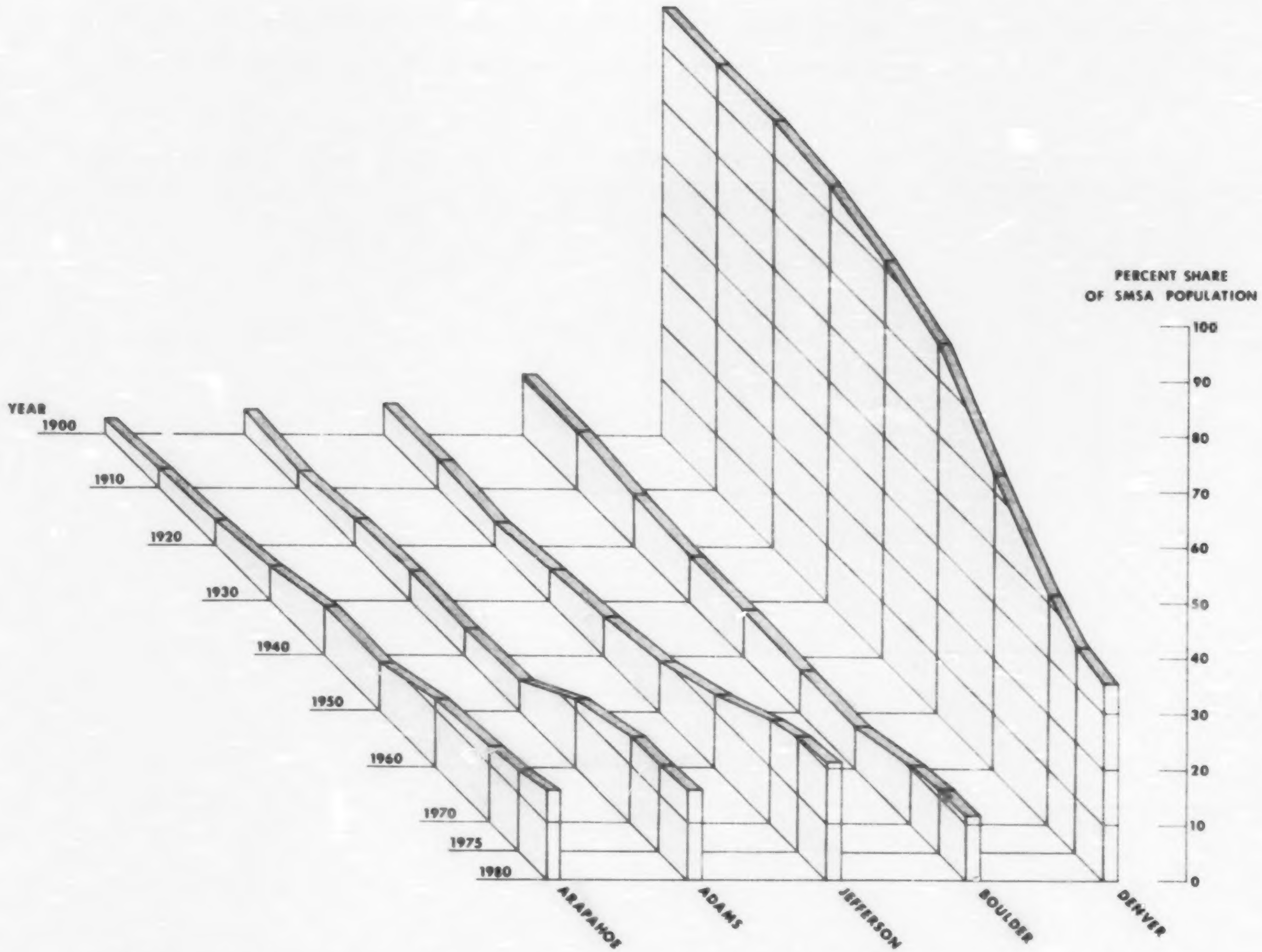
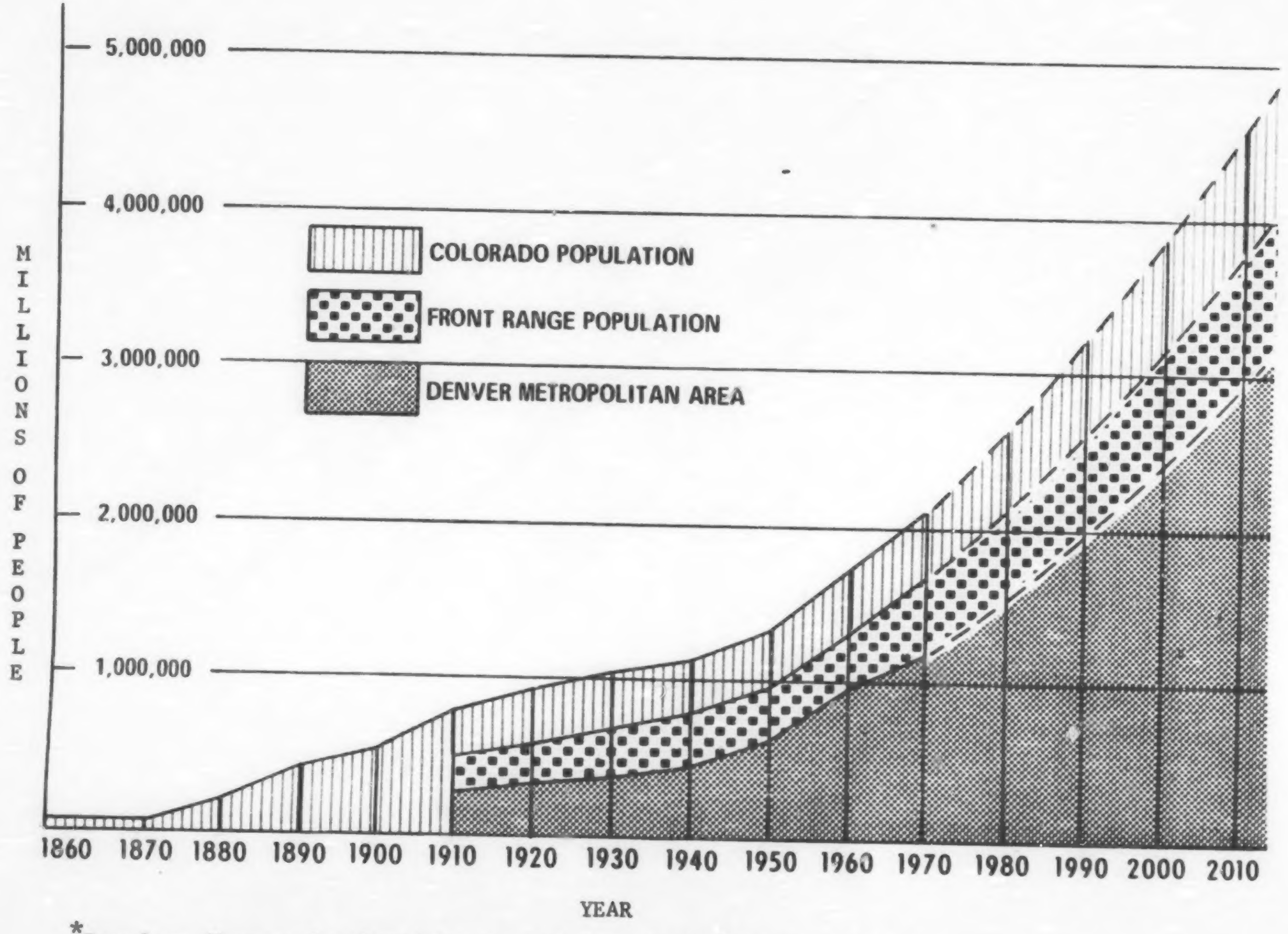


Figure 13. County shares of regional population 1900-1980 for Metropolitan Denver



*Based on figures developed by the Colorado State Planning Office

Figure 14. Present and projected population of Colorado and the Denver Metropolitan Area

The major components of population change for the Denver urbanized area include natural increase through increased births, and net migration. Of the two, net migration, or the difference between those coming into the area and those leaving, has been the most important. Both rural-urban migration and the relative stability of Denver's economy are cited as primary contributing factors for the large flux of the residents.

Density of population in the Denver central city, in 1970, was 7,602 per square mile and 198 beyond the central city. In general, this is a low suburban density and is partially because Denver is relatively isolated from other major cities. Additionally, people have shown a preference for open space in the metropolitan area, supported by the high mobility afforded by the automotive-dominant transportation system and extensive highway network. The overriding characteristic of the region is this low population density and dispersed growth pattern. The current patterns of sprawling low density suburban areas have contributed to planning difficulties in mass transit system development and regional dependence on private automobile travel.

Growth in Larimer and Weld Counties has been made more dramatic, especially for their major cities. While the growth rate has been fairly consistent in the past, the recent trend has been an acceleration of growth. Between 1960 and 1970 Fort Collins had a 73.2 percent rate of increase, Loveland had a 66.6 percent increase, and Greeley had an increase of 47.8 percent. It should be noted that the two cities that increased the most between 1960 and 1970 were both located in Larimer County, which itself underwent a growth of 68.5 percent over the previous decade. Weld County, as a whole, only had a growth rate of 23.4 percent during the same time period, which is less than that for the entire State and indicates a slow rate of increase in population in the rural districts. Data relating to the past growth of population in these two counties is presented in Table 6.

Table 6. POPULATION IN LARIMER AND WELD COUNTIES, 1940-1970[a]

County	Area	1940	1950	1960	1970	Growth rate 1960-1970
Larimer		N/A	43,554	53,343	89,900	1.685
	Urban	N/A	21,710	34,761	59,557	1.713
	Rural	N/A	21,844	18,582	30,343	1.633
	Fort Collins	12,251	14,937	25,027	43,337	1.732
	Loveland	6,145	6,773	9,734	16,220	1.666
Weld		N/A	67,504	72,344	89,297	1.234
	Urban	N/A	20,354	26,314	41,472	1.576
	Rural	N/A	47,150	46,030	47,825	1.039
	Greeley	15,995	20,354	26,314	38,902	1.478

N/A - Data not available

[a] Source: MacPhail, D.D., "Land Use Patterns, Practices, and Problems in the Poudre Triangle of Northern Colorado," University of Colorado.

Projections of population for Larimer and Weld Counties have been made to the year 2,000, based on migration and natural increase. These projections are given in Table 7. These projections indicate a decreased population growth rate for Larimer County but an increase in the growth rate of Weld County. A major factor influencing the growth in Weld County after 1970 is an expected increased migration of persons to the area as a result of increased employment potentials in the City of Windsor.

Housing

The Denver SMSA has a strong single-family housing structure tradition, with single-family homes comprising from 65 percent of all housing units in Denver County to 88 percent in Adams County in 1970, or an urbanized area average of 75 percent. Projections of housing stock for Denver indicate that single-family homes will continue to capture approximately half the new housing units with an increased trend toward

Table 7. PROJECTED POPULATION IN LARIMER AND WELD COUNTIES 1970-2000[a]

County	Area	1970	1980	1985[b]	1990
Larimer		89,900	135,000	167,500	200,000
	Ft. Collins	43,337	65,000	77,500	90,000
	(Ft. Collins Area)	(48,000)	(70,000)	(85,000)	(100,000)
	Loveland	16,220	25,000	31,500	38,000
	(Loveland Area)	(20,000)	(28,000)	34,000	(40,000)
	Unincorporated and rural areas	16,086	24,800	29,775	34,750
Weld		89,297	125,000	152,500	180,000
	Greeley	38,902	55,000	65,000	75,000
	(Greeley Area)	42,000	60,000	70,000	80,000
	Windsor	1,564	8,000	12,500	17,000
	Unincorporated and rural areas	28,760	31,685	31,500	31,315

[a] Source: Larimer-Weld Regional Planning Commission

[b] 1985 data is derived on a linear interpolation between the population in 1980 and 1990

low-rise, multiple-unit complexes and cluster-type developments. This development breakdown is sensitive to a wide range of economic, social and service related factors including transportation accessibility.

Low density and dispersed residential development patterns characterizing the regions are expected to continue with circumferential growth occurring from city centers and radial growth along transportation corridors. Other housing trends, such as a declining number of persons per housing unit and popularity of low density residences, are expected to continue based on existing trends, economic forces and social attitudes. These residence patterns are crucial in regional development planning, public transit system development and selecting transportation control measures designed to alter travel patterns to attain a shift in modal mix that both meets transit needs and minimizes air pollution and other environmental degradation.

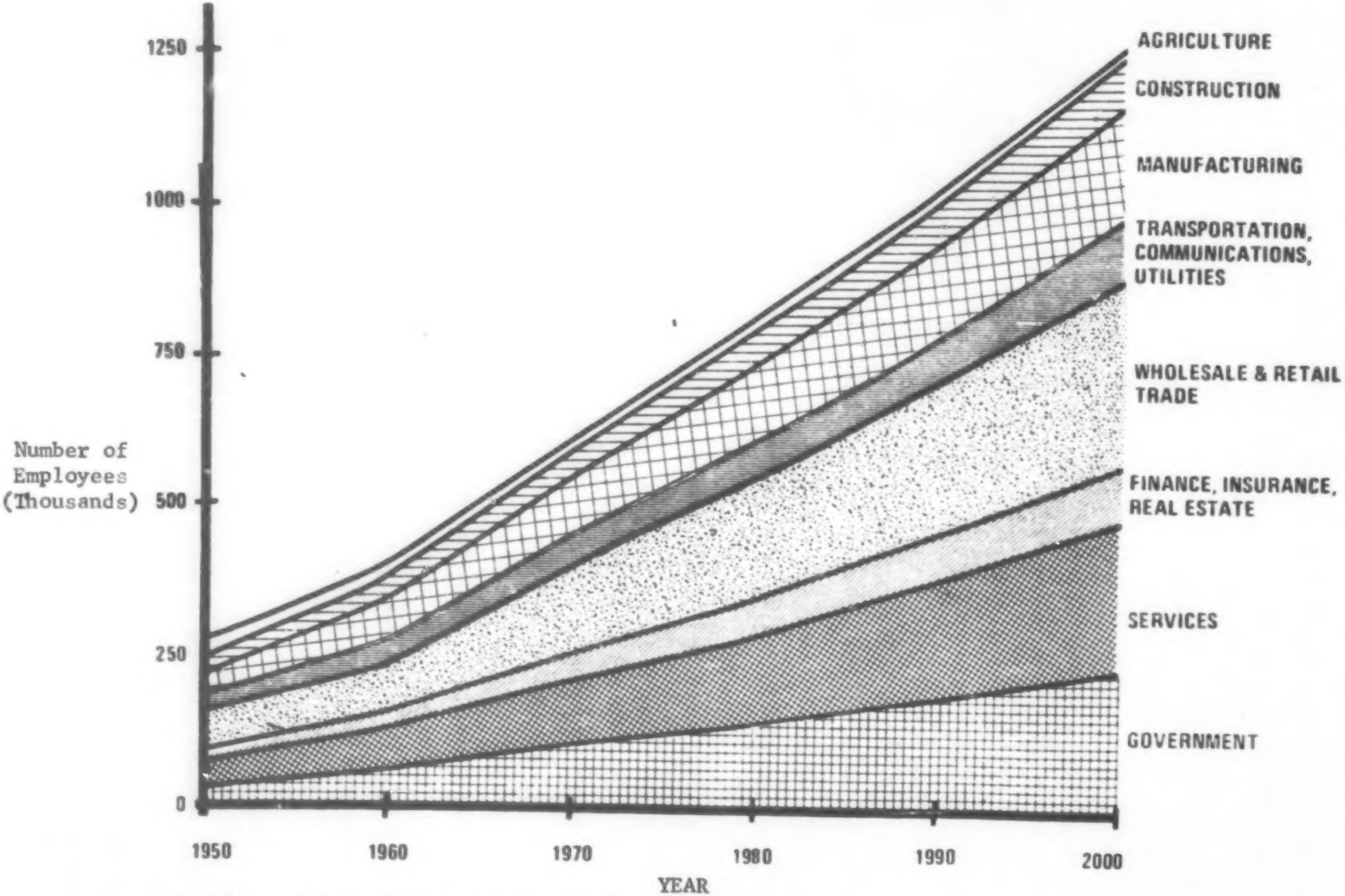
Employment

The metropolitan Denver region has shown relatively healthy economic performance in the past decade, with total employment in the region increasing by 30 percent between 1964 and 1970. This represents an annual compound growth rate of 4.5 percent per year. The 1970 labor force for the area was approximately 550,000, with 26,000 employed by the Federal Government. In addition to the large Federal labor force, the Denver region also contains large State and local government labor forces (City and County employees) since Denver is the principal governmental and political center in Colorado. This large work force, under direct government control, characterizing the Denver region may be an important feature influencing the applicability and potential effectiveness of various control measures such as staggered work hours and carpooling that require transport system user cooperation.

Based on analysis of industrial groups and employment trends, the Denver Regional Council of Governments (DRCOG) has projected employment growth trends by industry group to the year 2000 for the metropolitan Denver area. Figure 15 displays the present industrial group employment mix and projected growth trends by DRCOG. Table 8 provides the forecasted annual rates of employment growth for the Denver region by industrial type. These employment growth projections show that higher than average total employment growth will be experienced by three industries: (1) finance, insurance and real estate, (2) services, and (3) government. Approximately average growth will occur in industries: (1) construction, and (2) wholesale and retail trade. Employment growth rates of two industrial groups will be consistently below the rate of growth in total employment: (1) manufacturing, and (2) transportation, communications and utilities. One industry, agriculture, however, is projected to have a negative growth rate.

Approximately two-thirds of the employment growth between 1964 and 1970 occurred in Denver County, while about 95 percent of the population growth was in surrounding counties. This indicates an inward work trip transportation flow for the region. Figures 18 and 19 show the 1970 and projected 1980 employment density mapping for the Denver region. The density pattern illustrates that employment will not disperse significantly through the region, but will continue to be concentrated in the core region, thus requiring continued commuter traffic. Some services have followed the residential development in the suburbs, but as yet no clear proliferation of industrial development is apparent.

Based on a census week in 1970, only 4.2 percent of the workers in the Denver SMSA traveled to work on public transportation. The majority of the workers, 74.8 percent, drove private automobiles while 10.4 percent were passengers in private autos, and 8.5 percent walked to or from their place of work. Table 9 summarizes this census data on means of transportation to place of work.



Source: Denver Regional Council of Governments

Figure 15. Present and projected employment by industry group in the metropolitan Denver region

Table 8. FORECASTED ANNUAL RATES OF EMPLOYMENT GROWTH, METROPOLITAN DENVER 1970-2000

Industry category	Forecasted annual rate of growth 1970-1980 (%)	1980-1990 (%)	1990-2000 (%)
Agriculture	-0.8	-1.1	-1.6
Mining	0.2	0.4	0.4
Contract construction	3.2	2.4	1.9
Manufacturing	2.8	2.2	1.7
Transportation, communication and public utilities	2.7	2.7	1.6
Wholesale and retail trade	3.0	2.3	1.8
Finance, insurance and real estate	3.8	2.8	2.1
Services	3.4	2.6	2.2
Government	3.6	2.7	2.4
Total	3.1	2.4	2.0

Source: The Denver Regional Council of Governments

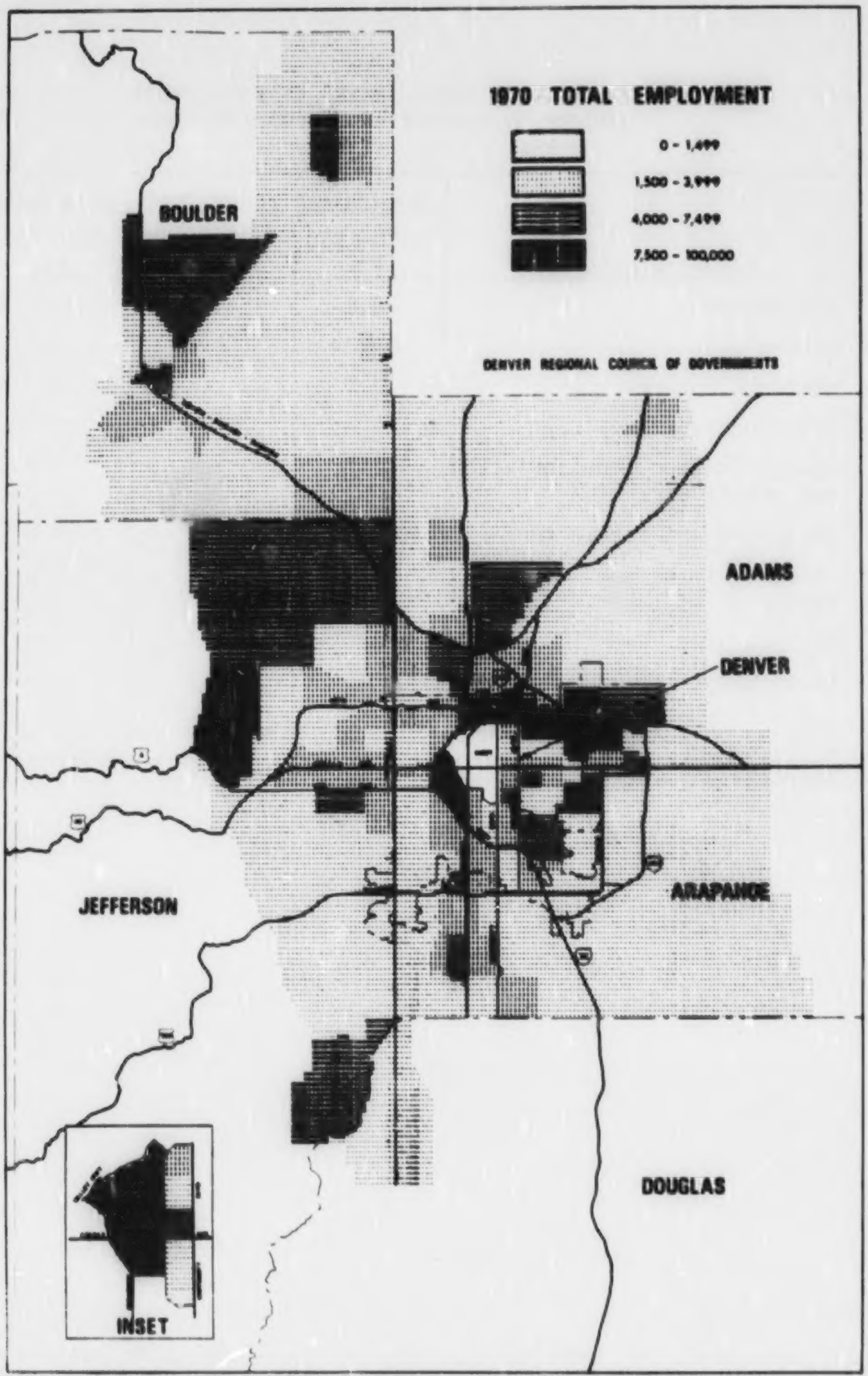

1970 TOTAL EMPLOYMENT
0 - 1,499
1,500 - 3,999
4,000 - 7,499
7,500 - 100,000
DENVER REGIONAL COUNCIL OF GOVERNMENTS
BOULDER
ADAMS
DENVER
JEFFERSON
ARAPAHOE
DOUGLAS
INSET

Figure 16. 1970 Employment density per acre

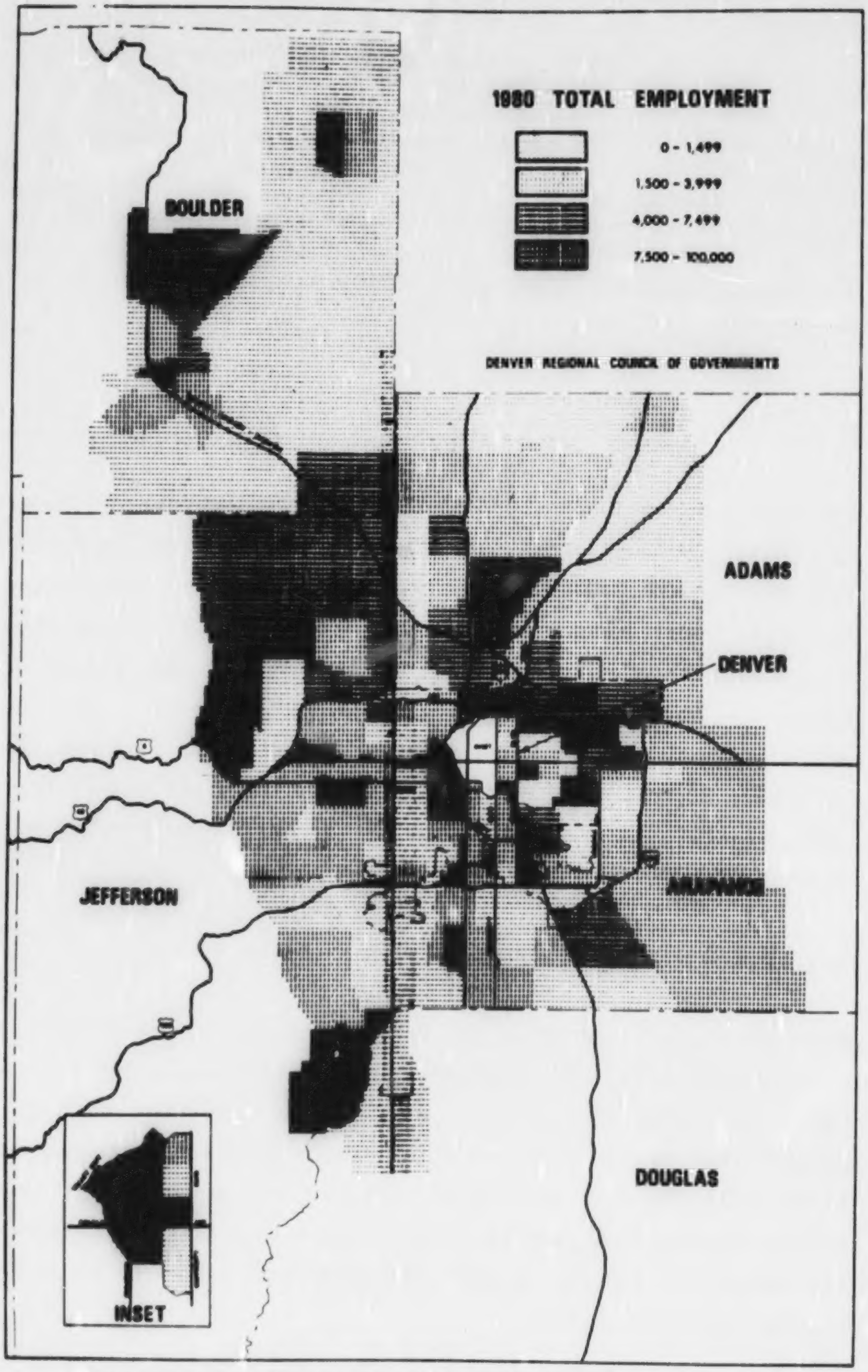

1980 TOTAL EMPLOYMENT
0 - 1,499
1,500 - 3,999
4,000 - 7,499
7,500 - 100,000
DENVER REGIONAL COUNCIL OF GOVERNMENTS
BOULDER
ADAMS
DENVER
JEFFERSON
ARAPAHOE
DOUGLAS
INSET

Figure 17. 1980 Employment density per acre

Table 9. MEANS OF TRANSPORTATION TO PLACE OF WORK IN THE DENVER SMSA

Transit mode	Worker responses	% of Total
Private auto (driver)	369,130	74.8
Private auto (passenger)	51,418	10.4
Bus, streetcar, or rail	20,675	4.2
Walked to work/and home	41,919	8.5
Other	10,424	2.1

Employment in the Denver CBD is primarily "white-collar" managers, executives, professionals, and clerical workers from the governmental, finance, service, and distributive type industries. The larger manufacturing complexes are away from the central area. "Blue collar" employment centers are dispersed throughout the Metropolitan area with medium and small-size firms within the central city. Many blue collar and unskilled jobs are relatively near to transit-dependent areas in actual miles, but are beyond normal commuting distances of the existing public transit services or are served by an indirect system of circuitous and time-consuming transfers.

Other Socio-Economic Characteristics

Numerous factors affect an individual's choice of travel mode, frequency of trip generation and origin-destination patterns. Age distribution, race, and income are important variables in assessing the impact of control measures on transportation demand behavior patterns, and in identifying the distribution of social and economic impacts implied by alternative control plan measures. These demographic characteristics are summarized for the Denver SMSA population in Table 10 and are briefly discussed below.

Table 10. DEMOGRAPHIC CHARACTERISTICS FOR THE DENVER STANDARD METROPOLITAN STATISTICAL AREA, 1970

Income

($) Family income class	Family total	Percent of total
< 3,743 (poverty)	20,572	6.8
< 4,999	43,172	14.2
5 - 14,999	185,713	61.0
>15,000	75,580	25.0
MEDIAN FAMILY INCOME = 10,777		

Population age distribution

Age class	Number of persons	Percent of total
<15	362,195	29.5
<19	477,904	38.9
20-54	564,078	46.0
>55	185,547	15.1
>65	95,046	7.7

Population with minority groups

Group category	Number of persons	Percent of total
White[a]	1,021,447	83.2
Spanish Surname	138,928	11.3
Black	50,164	4.1
Other	16,990	1.4
Total	1,227,529	100.0

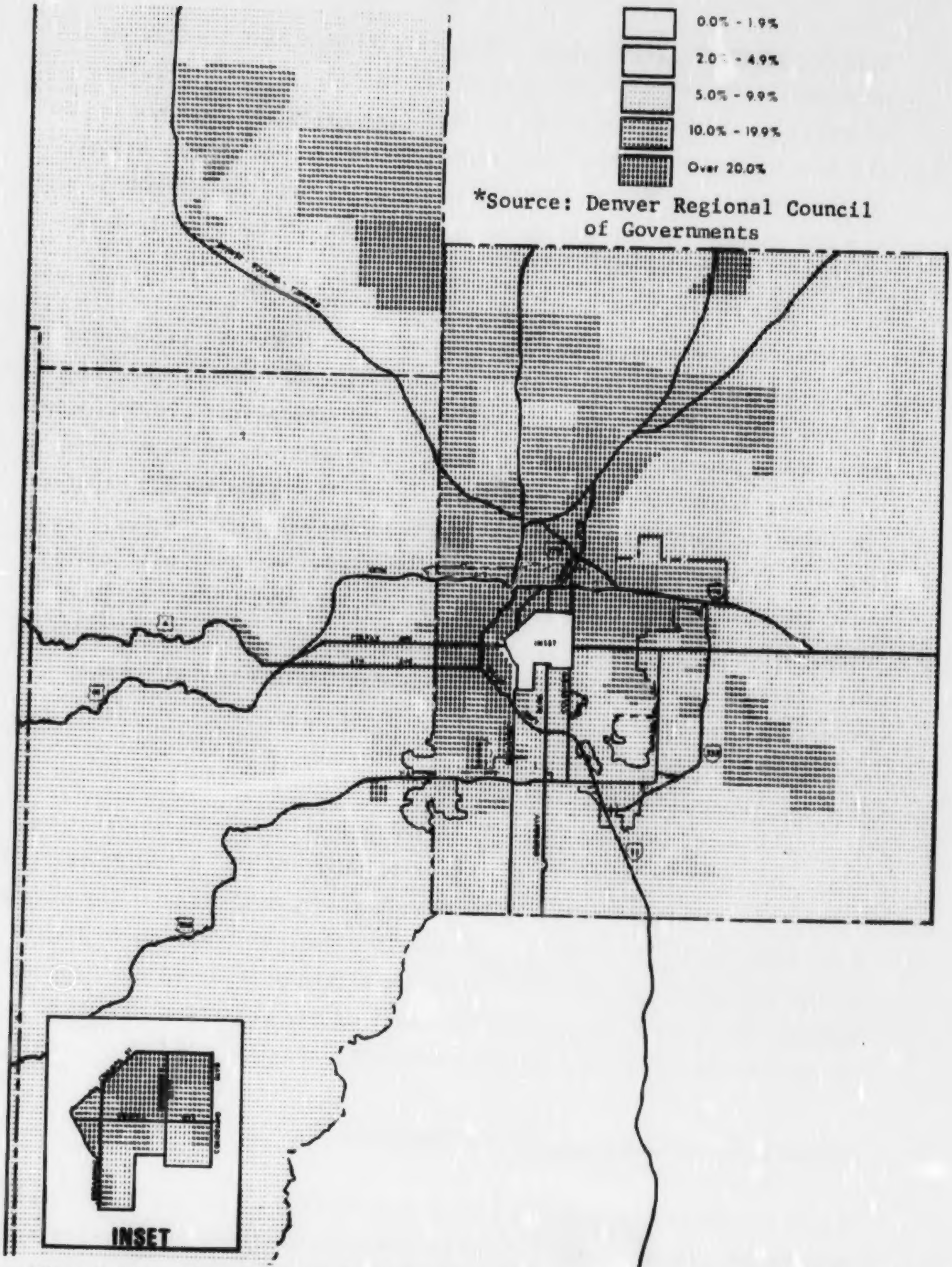
[a] Without Spanish surname

Income and Economic Stability - In 1969 the median income within the Denver Central City was $9,654 and $10,777 for the metropolitan area as a whole. Households in the Denver SMSA with income over $15,000 included 25 percent of the total, while 6.8 percent of the SMSA families had income below the poverty level in 1969. Of those families below the poverty level, 24.6 percent were receiving public assistance income.

The rural areas of the State of Colorado are less well off. The per capita adjusted gross income in 1970 was $3,129 in the Denver metropolitan communities, while it was $2,152 for the rest of the state. The percent of families below the poverty level in Larimer and Weld Counties was 9.4 and 11.9, respectively; and the median incomes were less than the average for the state.

Age Distribution - The 1970 Denver SMSA population age distribution shows a large and growing proportion of the residents in the younger age groups. In the younger age category, 29.5 percent of the population is less than 15 years of age. At the opposite end of the age spectrum 15.1 percent of the Denver population is older than 55, with 7.7 percent being older than 65 years. While the younger age groups are not so dominant in Larimer and Weld Counties, they still comprise over 25 percent of the population.

Minority Group Population Trends - For the five county Denver Metropolitan region, 4.1 percent of the 1970 population base was black and 11.3 percent had Spanish surnames in 1970. The growth trend from 1960 to 1970 shows a 23 percent increase in the white population, 59 percent increase in persons of the Negro race, and 132.5 percent increase in persons with Spanish surnames. Larimer and Weld Counties have less than 2 percent non-white population. Figure 18 illustrates the geographic distribution of minority groups in the metropolitan area, with highest densities occurring in the central city regions.


0.0% - 1.9%
2.0% - 4.9%
5.0% - 9.9%
10.0% - 19.9%
Over 20.0%
INSET
INSET

*Source: Denver Regional Council of Governments

Figure 18. Minority population as a percentage of total population*

Transit-Dependent Population - The transit-dependent population is generally composed of individuals from the following interrelated sectors: low income, minorities, elderly, young, and students. In the Denver region, transit-dependent groups include people too old or too young to drive cars or too poor to maintain an automobile or provide enough car service to meet all of the household's transit needs.

The greatest concentration of transit-dependent people in the Denver region is in a 28 square mile area including the Denver CBD, the area to the north, and the Five Points area, housing nearly 170,000 people. Travel via present public transit to employment is, on an average, 3.5 times longer than the same trip by car according to RTD studies. In addition, public transit provides minimal off-peak service. Proposed improvement in the public transportation services will therefore incur differential impacts in the Denver AQMSA based on local economic conditions, the composition and spatial distribution of population subgroups, and behavioral responses to changes in travel opportunities.

AIR QUALITY AND PLANNING AGENCIES

There are many agencies in the State of Colorado which are directly or indirectly concerned with the maintenance of air quality. These agencies range from the state's Air Pollution Control Division to local planning boards. Those which are most actively involved in the development, implementation, and enforcement of air pollution maintenance strategies in the Denver AQMSA are briefly discussed below.

Colorado Air Pollution Control Commission

The Colorado Air Pollution Control Act of 1970 (Appendix B) created the nine-member Colorado Air Pollution Control Commission to develop an effective air pollution control program and promulgate such regulations as may be necessary or desirable to "achieve the maximum practical degree of air purity in every portion of the state." Eight members of the Commission are appointed by the governor with the consent of the Senate for a term of three years and the other member is from the State Board of Health.

The duties of the Air Pollution Control Commission include the development and maintenance of a comprehensive program for prevention, control, and abatement of air pollution throughout the entire state, including a program for control of emissions from all significant sources of air pollution; the promulgation of ambient air goals for every portion of the state; the adoption and promulgation of ambient air quality standards and emission control regulations; the receipt and, at its discretion, the hearing and determination of violations and applications for the granting of variances; and, at its discretion, the review of any variance order or determination of the variance board to which such applications may have been transmitted. The Commission must also hold a joint meeting with the State Board of Health during the month of October of each year in order to hear public comment on air pollution problems within the state and to answer questions from the public concerning the administration and enforcement of promulgated rules and regulations.

The Air Pollution Control Commission currently has on its staff a technical secretary, a health educator, and a principal clerk-stenographer. The budget (FY 1974) for the Commission, its staff, and the Variance Board, is $84,898.

Colorado Air Pollution Control Division

The Colorado Air Pollution Control Act of 1970 also established a division within the Department of Health to administer and enforce the air pollution control programs adopted by the Commission. Specifically, the Division is empowered to conduct studies and research with respect to air pollution, including the control, abatement, or prevention thereof; determine if the ambient air standards are being violated in any area of the state; enter and inspect any property, premise, or place for the purpose of investigating any actual, suspected, or potential source of air pollution; furnish technical advice and services; notify any affected jurisdiction of standards which are not being met; and to issue contaminant emission notices. The Division also has the authority to enforce compliance with the promulgated emission control regulations.

The Department of Health, within which the Air Pollution Control Division was established, is designated as the "state agency" for all purposes of the Federal Clean Air Act, as amended, and regulations promulgated under that act. The Department of Health accepts and supervises the administration of loans and grants from the Federal government (and from other sources, public or private) which are received by the state for air pollution control purposes.

An organizational chart for the Air Pollution Control Division is presented in Figure 19. Current staffing levels and the budget (FY 1974) are presented in Table 11.

Colorado Division of Planning

The Division of Planning serves as an advisory and coordinating agency with no regulatory authority. It was created within the Department of Local Affairs to, among other things, prepare planning "for meeting problems in the areas of highways, air and water pollution, water supplies, sewage disposal, recreation, urban and nonurban growth, transportation, education; industrial and commercial development, and related matters."

The duties of the Division of Planning are primarily those of assistance in the gathering and using of data. It also helps to coordinate the planning activities of other departments or agencies, at the state and local level, to ensure a degree of harmony. The population statistics, estimates, and projections prepared, maintained, and interpretated by the

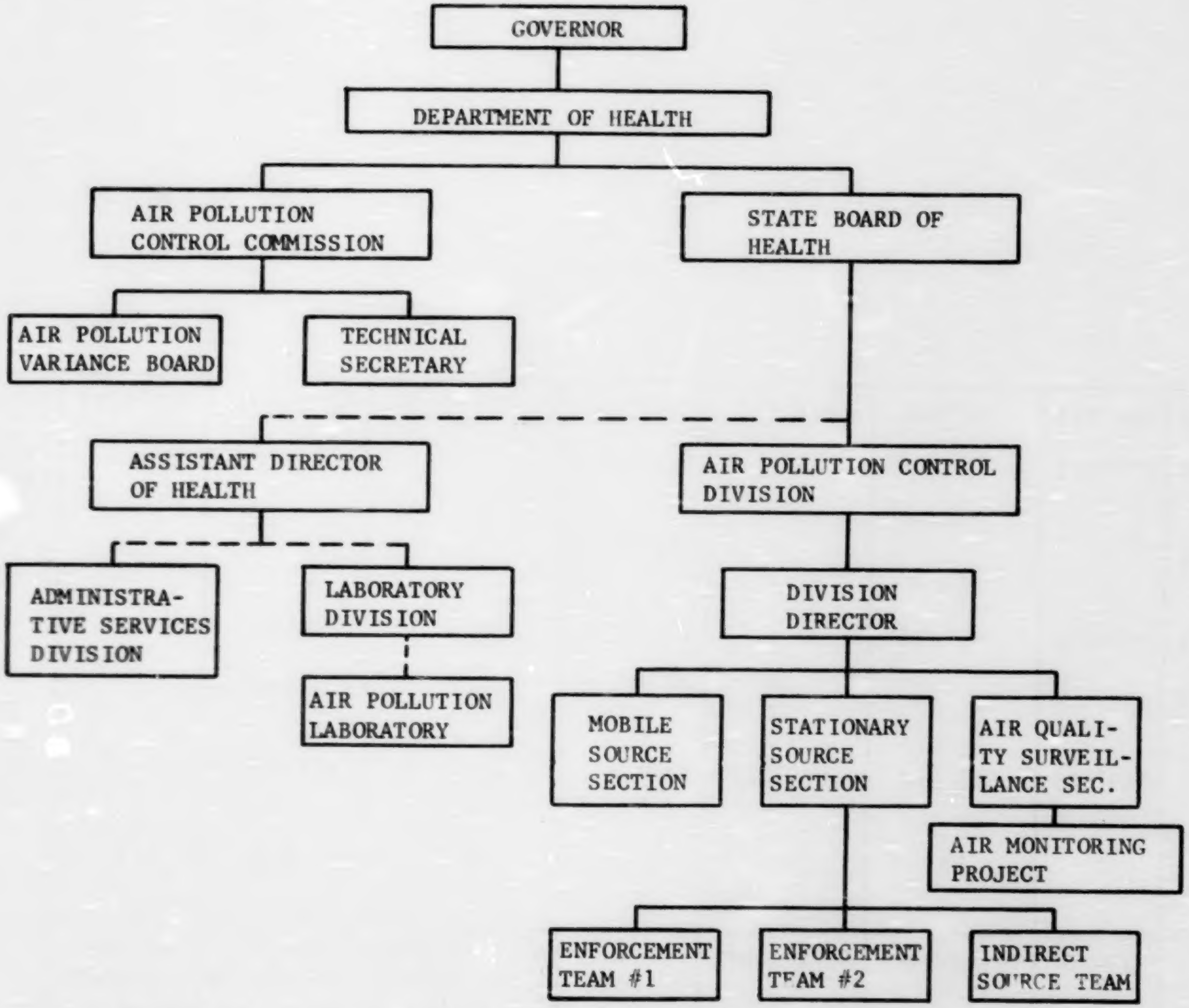

GOVERNOR
DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL COMMISSION
STATE BOARD OF HEALTH
AIR POLLUTION VARIANCE BOARD
TECHNICAL SECRETARY
ASSISTANT DIRECTOR OF HEALTH
AIR POLLUTION CONTROL DIVISION
ADMINISTRATIVE SERVICES DIVISION
LABORATORY DIVISION
AIR POLLUTION LABORATORY
DIVISION DIRECTOR
MOBILE SOURCE SECTION
STATIONARY SOURCE SECTION
AIR QUALITY SURVEILLANCE SEC.
AIR MONITORING PROJECT
ENFORCEMENT TEAM #1
ENFORCEMENT TEAM #2
INDIRECT SOURCE TEAM

Figure 19. Organization chart for Air Pollution Control Division

Table 11. BUDGET: COLORADO AIR POLLUTION CONTROL ACTIVITIES (FY 1974)

	Adminis-tration	Stationary sources	Air quality surveillance	Mobile sources	Laboratory	Commission	Other	Total
Staffing level	8	12	13	9	7	22	2	73
Personnel services	$105,254	$159,819	$178,395	$ 99,519	$72,330	$69,598	$23,651	$ 708,566
Operating expenses		$83,027		$ 25,300				$ 108,327
Travel	$ 3,600	$ 21,387	$ 9,900	$ 12,000		$15,300	$ 2,480	$ 64,667
Capital outlay		$ 450		$ 52,410				$ 52,860
Contractual services				$191,686			$32,650	$ 224,336
Total	$136,530	$209,332	$215,970	$380,915	$72,330	$84,898	$58,781	$1,158,756

Division of Planning are designated as the official data. Besides the compilation of such demographic data, it must also prepare and periodically revise an inventory of the public and private natural resources, major public and private works, and other facilities and information deemed to be important for the planning and development activities of the state.

The Division of Planning's primary input to the development and implementation of an air quality maintenance plan, aside from the use of its data, is the use of its function as the A-95 clearinghouse. It therefore has the responsibility of identifying appropriate state and local environmental agencies which should be made aware of a proposed project for which a Federal grant is being requested and regulating their input. This Project Notification and Review System focuses on coordination at the beginning of a project application process and provides an early warning before positions and viewpoints have been solidified. Its significance for air quality maintenance planning is that it provides a structure for improving comprehensive planning and strengthens the communication between agencies and different government levels.

All master or zoning plans, prepared by any region, county, or district planning commission, must be submitted to the Division of Planning before their adoption or certification. The Division of Planning reviews each plan and presents its advice or criticism; however, the planning commission submitting such plan is not bound by the advice or criticism, which is considered to be advisory only.

Colorado Land Use Commission

The Colorado Land Use Act established, within the Office of the Governor, the Colorado Land Use Commission in order to provide the leadership necessary to encourage planned and orderly land use development. To fulfill this responsibility, for the past three years the Land Use Commission has been working to identify a program that will provide a framework and a process whereby the State of Colorado and its various political subdivisions can guide future development. This has culminated in a report entitled, "A Land Use Program for Colorado", which is discussed, as it relates to air quality maintenance planning, below.

In fulfilling its mandate, the Commission identified five regions consisting of groups of counties which demonstrate similar dominant characteristics and problems. Of particular interest to this AQMP is the Front Range Land Use Planning Region which includes the AQMSA and Teller, El Paso, and Pueblo Counties. The Commission also identified four substantive arenas which are inseparable from land-use questions--environment, economics and population, natural resources, and social concerns; defined goals and targets in each of these arenas, working in consultation with various interest groups all over the State; agreed upon general policies to guide the land-use program; developed programs in each of the four broad arenas, for each of the five regions and for the State as a whole; and considered what legislation, organizational mechanisms, and implementation actions are needed to carry out the Commission's land-use program recommendations.

Given the diversity of regional needs, the Commission had to formulate a set of goals for the State, reflecting regional diversity yet providing a focus for a statewide land-use policy. The Commission first formulated broad goals, and then outlined targets (what ought to be done, where and by when) and policies (who ought to do what, and how). Next came the consideration and adoption of program elements (the tools for carrying out the policies), and finally the development of an organizational structure and a set of short- and long-term strategies. The Commission adopted goals for four of the major arenas related to land use.

Land-use goals relating to the environment were identified as follows:

1. Control development to conserve natural environmental amenities, including air and water.
2. Control development in hazardous or environmentally fragile areas.
3. Provide adequate recreation opportunities.
4. Conserve areas of scenic beauty or special interest.

With respect to economic development and population in the Front Range Land Use Planning Region a goal of encouraging moderate growth was established. To moderate economic and population growth in the Front Range Land Use Planning Region and to attract new growth to other parts of the State, the Commission recommends a combination of incentives and disincentives, to be introduced in connection with the "growth centers" concept. Growth centers would be designated by the regions in consultation with the State Land Use Agency, the Division of Commerce and Development, and other agencies that will play a key role in their development (e.g., Highways and Budget).

The goals for the environment and for economic and population growth are considered to be the mainspring of State land-use policy while goals for natural resources and social concerns support the two primary sets of goals. Principal goals for natural resources are to:

1. Establish a State energy policy with respect to mining and energy-using development.
2. Develop fuel and non-fuel minerals in a manner which is compatible with environmental goals and which furthers economic growth (particularly in the Northwest).
3. Initiate measures to inhibit land uses which result in the unnecessary conversion of prime agricultural land.
4. Establish a State forest policy.
5. Encourage effective and rational use of the State's water resources.

Land-use related social goals are to:

1. Provide for explicit analysis of social implications and impacts of public or major private land-use decisions, as in provision of and access to health, educational, recreational, housing, and employment opportunity.
2. Provide adequate access to services and provision of housing and employment for indigenous and/or disadvantaged populations impacted by public or private land-use decisions.
3. Ensure opportunity for preservation of cultural heritage where threatened by public or major private land-use decisions.

Each goal is further supported by one or more targets which express intermediate goals of highest priority, with greater specificity and a time frame for implementation.

The development and adoption of these types of land-use-related goals and targets is the first step in defining a land-use planning program for air quality maintenance planning. The statement of goals in these broad areas--environment, economic and population development, natural resources, and social concerns--becomes the initial guidance for developing programs at the State, regional, and local levels.

Of particular interest to the development of an air quality maintenance plan is the program outlined for the environment. The Commission recommended a three-pronged approach to the achievement of environmental goals. As a first element, environmental inventories would be prepared and plans made that reflect the location of significant natural amenities and ecosystems, as well as scenic, cultural, and historic resources. The identification of these critical environmental areas will, in turn, guide the administration of land-use and environmental regulatory programs, including a new development permit system.

A development permit system would apply to all developments located in areas of critical environmental concern and to proposed activities of regional or State significance. The granting of a permit will be the function of regional permit boards within the five regions of the State, with appeals to a State Permit Review Board. The criteria for determining when a permit is needed, whether it should be granted and what restrictions or conditions should be attached to it will thus be responsive to regional differences. Permit decisions will reflect a comprehensive review of the proposed development's effects on the environment, public services, and existing public infrastructure. Public hearings on permits will be conducted at the regional level, with an opportunity for citizen participation. This permit system, along with strengthening of local land-use controls, and improvements in state regulation of environmental quality, make up the second element in the recommended environmental strategy.

The third element looks toward the creation of a Special Land Agency, a state-owned corporation empowered to acquire environmentally critical lands, or partial interests in these lands, such as scenic easements, and to help provide accessible recreational opportunities for Coloradans. In urban and urbanizing areas, the Commission suggests the creation of linear parks along rivers and streams or other environmental corridors. Such parks would preserve both shorelines and other environmental qualities.

They would also provide a variety of recreational opportunities closer to major population centers. The concept of linear parks could also be applied on a larger scale to control strip development, especially in mountain valleys, so as to preserve or restore the environment while promoting access to public recreational lands. The Special Land Agency, besides pursuing these important environmental goals, could begin to intervene in the land market to provide inducements for orderly growth. The Special Land Agency could also exchange or transfer land that the federal government decides to dispose of.

Joint Regional Planning Program - Denver SMSA

The Denver Metropolitan region is Colorado's major urbanized area. The Denver Standard Metropolitan Statistical Area (SMSA) consists of more than 200 political entities, located in, and including, the counties of Adams, Arapahoe, Boulder, Denver, and Jefferson. Included are municipalities, school districts, sewage districts, water districts, park and recreation districts, fire districts, and other special purpose districts. The responsible agency for comprehensive planning in the Denver SMSA is the Denver Regional Council of Governments. The responsibility for continuing, comprehensive, and cooperative transportation planning rests with the Joint Regional Planning Program (JRPP). The JRPP is a cooperative transportation planning effort carried out jointly by the Denver Regional Council of Governments (DRCOG), the Regional Transportation District (RTD), and the Colorado Division of Highways (CDH).

Consistent with its role as intergovernmental coordinator for the SMSA region, the Council of Governments coordinates the joint planning effort with federal, state and local units and agencies of governments. In carrying out this role, the Council makes application for federal assistance to the planning program, coordinates the planning program with planning for all modes of transportation, coordinates the needs and findings of the planning program with units of local government, coordinates with state planning efforts, and, upon adoption, certifies the land use and public transportation plans to the federal government. General policy guidelines are established cooperatively by the policy bodies of each agency. The staffs of the Council of Governments, the Regional Transportation District, and the Colorado Division of Highways have responsibility for management and control of the planning elements and tasks assigned to their respective agencies. Specific planning responsibilities of the agencies are outlined below.

Denver Regional Council of Governments Activities - Those activities of the Denver Regional Council of Governments which are instrumental in the Joint Regional Planning Program are detailed below:

> Comprehensive Planning Information - Preparation of regional goals and objectives, estimates and projections of population counts and characteristics, socioeconomic/employment information, land use, identification of natural and man-made physical characteristics influencing regional development, identification and projection of community facilities and service requirements, and preparation of land development criteria and standards.
>
> Urban Development Plans - Preparation, analysis, and evaluation of regional development plans based upon alternative development policies.
>
> Joint Development with RTD and CDH of Transportation Plans - Preparation of transportation information, development of travel pattern data, preparation and evaluation of transportation models, preparation of transportation system criteria and standards, forecasts of regional travel demand, preparation and testing of alternative transportation corridors, and evaluation and selection of highway and public transportation plans.
>
> Continuing Development of Short and Long Range Plans and Planning Information - Continuing development and analysis of indicators of regional growth and change; coordination of planning program findings with public transportation operators and with the Colorado Division of Highways; monitoring of public action programs which may affect the planning program and development of short-range highway transportation plans which, combined with short-range public transportation improvements, will tend to raise the overall level of transportation service in the region.

Regional Transportation District Activities - These activities are listed below:

> Joint Development with DRCOG and CDH of Transportation Plans - Preparation of public transportation information, development of travel pattern data, preparation and evaluation of transportation models, preparation of transportation system criteria and standards, forecasts of regional travel demand, preparation and testing of alternative transportation corridors, and evaluation and selection of public transportation plans.

Detailed Long-Range Public Transportation System Plans - Estimates of system usage, line and station location studies, preliminary vehicle design, preparation of operating plans, preliminary engineering studies, detailed cost-benefit analysis, preparation of capital and operating cost estimates, and architectural and urban design studies.

Implementation Program - Preparation of financial program, preparation of construction phasing, examination of organizational and legislative programs, and preparation of a step-by-step implementation program.

Short Range Improvement Programs - Analysis of present bus ridership pattern, analysis of present route structure, identification of proper role for local transit service, analyzing deficiencies in present service, and preparation of a short-range public transportation improvement program.

Demonstration Programs - Identification, development and implementation of public transportation demonstration programs which will aid in ultimate development of the long-range public transportation plan and serve to demonstrate that modern public transportation is a viable alternative to automobile travel.

Public Education Program - Development and implementation of a community interaction and public information program designed to insure that any new public transportation plan is responsive to the needs and desires of the entire community and to provide for effective citizen participation in the public transportation planning process.

Community Approval - Sponsorship of public hearings, modification of public transportation plans as required, and submission of a plan for the development, maintenance, and operation of a public transportation system to the voters of the District.

Implementation of Plan - Upon favorable approval of the electorate and sale of authorized bonds, unification and operation of existing public transportation systems as well as construction of new facilities in accordance with the plan.

Continuing Development of Short and Long Range Plans - Together with the Council of Governments, continuing preparation of short and long range plans to meet public transportation needs and requirements of the region.

Colorado Division of Highways Activities - The activities of the Colorado Division of Highways related to the Joint Regional Planning Program are given below:

> Joint Development with DRCOG and RTD of Transportation Plans - Preparation of highway transportation information, development of travel pattern data, preparation and evaluation of transportation models, preparation of transportation system criteria and standards, forecasts of regional travel demand, preparation and testing of alternative transportation corridors, and evaluation and selection of highway transportation plans.
>
> Continuing Development of Short and Long Range Plans - Together with the Council of Governments and RTD, continuing preparation of short and long range plans to meet highway transportation needs and requirements of the region.
>
> Implementation of Highway Plans - Budgeting, engineering and construction of highway improvements resulting from the cooperative planning program.

Mechanism for Planning Coordination - There exists a Memorandum of Agreement between the Denver Regional Council of Governments, the Regional Transportation District and the Colorado Division of Highways, signed on April 16, 1971, and currently in effect. The Denver Regional Council of Governments, as the designated areawide planning agency and coordinating member of the Joint Regional Planning Program, has the capability to administer and coordinate all transit planning funds. The DRCOG also has the authority to contract with other agencies to provide and administer planning monies.

The organizational mechanism for accomplishment of the continuing, comprehensive, and coordinated intermodal planning process is illustrated in Figure 20. Policy for the planning process is established by adoptive actions of the Denver Regional Council of Governments, the Regional Transportation District Board of Directors, and the Colorado State Highway Commission. The composition of these policy bodies are as follows:

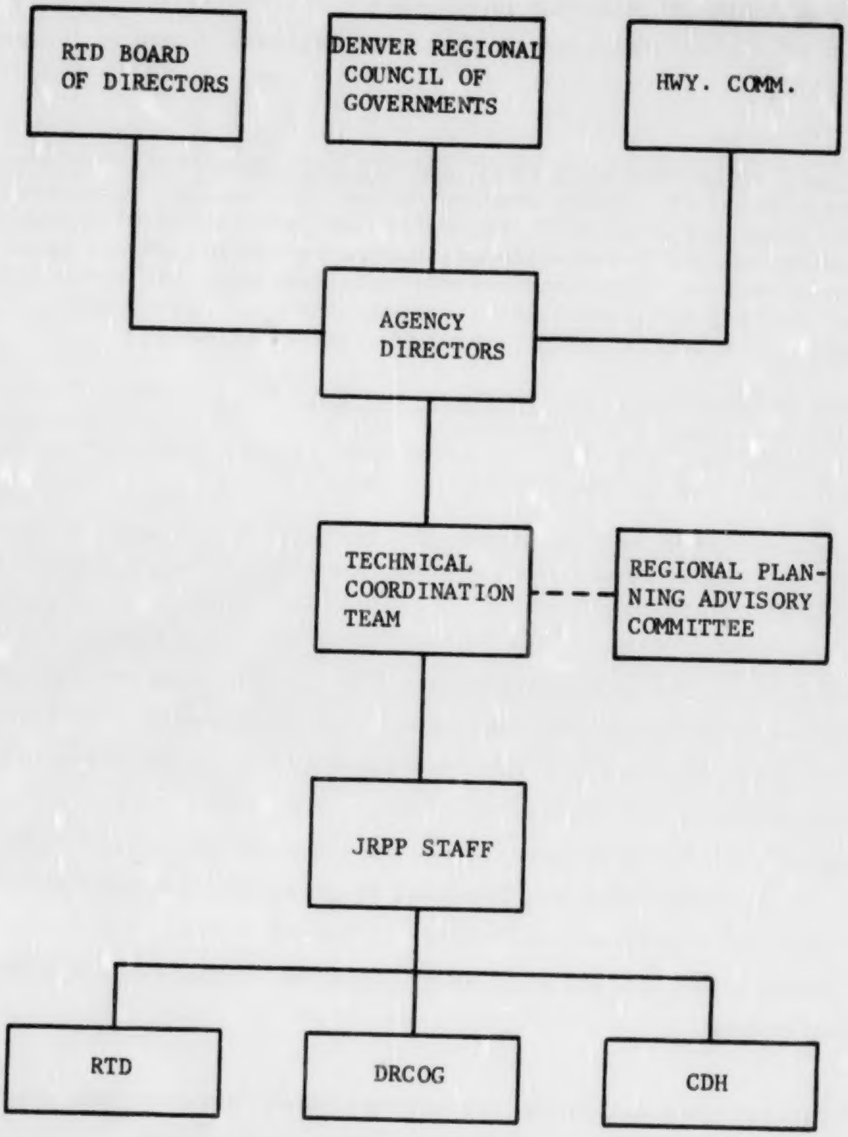

RTD BOARD OF DIRECTORS
DENVER REGIONAL COUNCIL OF GOVERNMENTS
HWY. COMM.
AGENCY DIRECTORS
TECHNICAL COORDINATION TEAM
REGIONAL PLANNING ADVISORY COMMITTEE
JRPP STAFF
RTD
DRCOG
CDH

Figure 20. JRPP: transportation and land use planning structure

Denver Regional Council of Governments - One county commissioner from each of the four counties in the region, the mayor and a city council member from the City and County of Denver, and the mayor or member of the city council from each of the twenty-eight incorporated cities and towns within the region.

The Regional Transportation District Board of Directors - Ten members appointed by the mayor of the City and County of Denver, and confirmed by the Denver City Council. Two members appointed from Boulder, Adams, Arapahoe, and Jefferson Counties and confirmed by a majority of the municipalities within each county, one member appointed by the county commissioners of Douglas and Weld Counties and confirmed by a majority of the municipalities within these counties, and one "at-large" member selected by the twenty appointed members of the Board of Directors.

Colorado State Highway Commission - One member from each of eight districts throughout the state, and one at-large member appointed by the Governor of the State of Colorado.

These policy boards meet on a regularly scheduled basis. The Denver Regional Council of Governments and the Regional Transportation District Board of Directors meet monthly, and the Colorado State Highway Commission meet quarterly.

The highest level of staff involvement in the Joint Regional Planning Program is the Committee of Agency Directors. It is composed of the Executive Directors of the Denver Regional Council of Governments and the Regional Transportation District, together with the Chief Engineer of the Colorado Division of Highways. This group meets as frequently as is necessary, but at least monthly for the purpose of monitoring the planning process, assuring that the work of the three agencies is carried out effectively, resolving interagency problems, and preparing policy and plan recommendations.

The Joint Regional Planning Program recognizes that the staff of each participating agency is responsible to its own agency's policy body; i.e., Council of Governments, RTD Board, and the State Highway Commission. These bodies determine policy within the scope of authority granted them under State statutes. It is expressly intended that each agency director seeks guidance from his own governing body and serves as a link between his governing body and the cooperative Joint Regional Planning Program. When conflicts between agencies occur, the Agency Directors, with the advice of their respective policy bodies, attempt to establish mutually satisfactory solutions. The Agency Directors are responsible individually for their agency's activities in support of the Joint Regional Planning Program, and collectively responsible for assuring that the Joint Regional Planning Program objectives are met.

Directing the day-to-day staff activities of the Joint Regional Planning Program is the responsibility of the Technical Coordination Team (TCT). The Technical Coordination Team is composed of the Program Director for Transportation and Land Development of the Denver Regional Council of Governments, the Senior Transportation Planner of the Regional Transportation District, and the Transportation Studies Engineer for the Colorado Division of Highways. It is the responsibility of this team to provide continuing coordination and liaison between the staffs of the participating agencies and to maintain the technical competence of the Joint Regional Planning Program. The TCT meets as frequently as necessary, but at least weekly throughout the program. Specific functions of the Technical Coordination Team are: making technical decisions, coordinating the activities of the three agencies toward accomplishment of objectives, reviewing and modifying schedules, preparation and review of work programs, preparation of periodic progress reports, and resolution of problems.

In order to provide continuing liaison between federal, state, and local agencies, and provide for effective input of their expertise, concerns, and desires, the Joint Regional Planning Program has designated the Council of Governments' Regional Planning Advisory Committee as a technical advisory committee to the transportation planning process. Voting members of the Regional Planning Advisory Committee represent the cities and counties of the region. While membership is not limited to particular professional disciplines, members are usually city planners or engineers. Also included on the committee, in a non-voting, associate capacity, are representatives of the Colorado State Planning Division, the State Land Use Commission, the Division of Highways, the Regional Transportation District, the Federal Highway Administration, the Department of Housing and Urban Development, the Bureau of Outdoor Recreation, and the Federal Aviation Administration. Meetings of the Regional Planning Advisory Committee are held at least monthly. While the transit operating agencies of the region are not directly represented on the Regional Planning Advisory Committee, representation is provided through the Committee's two members from the City and County of Denver.

Local Pollution Control Authorities

Colorado has a very strong interest in maintaining control over local problems in the jurisdiction of interest. As much as possible, initial regulatory control is placed in the local authorities with final control by the state only if necessary. The Colorado Air Pollution Control Act delegates to the local governmental agencies the authority to enforce the rules and regulations adopted by the Air Pollution Control Commission.

The local air pollution control authorities in the Denver Air Quality Maintenance Study Area are listed below:

County	Agency Title	Location
Adams	Tri-County District Health Dept.	Englewood
Arapahoe	Tri-County District Health Dept.	Englewood
Boulder	Boulder City-County Health Dept.	Boulder
Clear Creek	-	-
Denver	Denver Dept. of Health and Hospitals	Denver
	Denver Building Dept.	Denver
Douglas	Tri-County District Health Dept.	Englewood
Gilpin	-	-
Jefferson	Jefferson County Health Dept.	Lakewood
Larimer	Larimer County Health Dept.	Fort Collins
Weld	Weld County Health Dept.	Greeley

Local Planning Commissions

All counties in Colorado must have, and any municipality may have, a planning commission. Any such planning commission must prepare a comprehensive plan (master plan) for its jurisdiction. These plans are then officially adopted (after public hearings), and must be considered when decisions are made about certain types of facilities. Generally, however, the master plan has little legal effect on private actions as there is no requirement that zoning be in accordance with the community master plan. In Weld County, however, it is currently the policy to rely on the comprehensive plan in zoning decisions. Municipal, but not county, planning commissions must also review the locations of public thoroughfares, utilities, and open spaces.

The only regional planning commission which has been created in the Denver Air Quality Maintenance Study Area, other than the Denver Regional Council of Governments, is the Larimer-Weld Regional Planning Commission.

The current status of county master plans is summarized in Table 12.

REGIONAL LEGAL AUTHORITY FOR AIR QUALITY CONTROL

As stated in Part 51 of Chapter 40 of the Code of Federal Regulations (40 CFR 51) under section 51.11 which deals with the legal authority requirements for air quality implementation plan development:

> (a) Each plan shall show that the state has legal authority to carry out the plan, including authority to:
>
> (1) Adopt emission standards and limitations and other measures necessary for attainment and maintenance of national standards.

The Colorado State Air Pollution Control Act of 1970 (Appendix B) created the nine-member Colorado Air Pollution Control Commission. The Act

Table 12. COUNTY MASTER PLANS

County	Status of plan	Comments
Adams	In effect - urban portion only	About to update, extend
Arapahoe	Not yet developed	
Boulder	In effect - some portions of county	Boulder City has own plan
Clear Creek	Not yet developed	About to start
Denver	In effect - 1968	Parts updated since
Douglas	Not yet developed	
Gilpin	Not yet developed	In progress
Jefferson	In effect - some portions of county	Old
Larimer	Not yet developed	About to start
Weld	In effect - 1973	

designates the Colorado Department of Health to serve the State for all purposes of the Federal Clean Air Act, as amended, and to accept and supervise the administration of loans and grants from the Federal Government and other sources received for air pollution purposes. The Commission has the authority to develop and maintain a comprehensive program for prevention, control, and abatement of air pollution throughout the entire state including a program for control of all significant sources of air pollution and authority to promulgate ambient air control plans for every portion of the state.

(2) Enforce applicable laws, regulations, and standards, and seek injunctive relief.

Injunctive powers are expressly provided as an enforcement tool and heavy civil penalties ($2,500 per day for each day of offense) may be levied upon violation of any final cease or desist order not under judicial review or failure to file the required air contamination emission notice.

The Division of Administration of the Colorado Department of Health is the enforcement authority for the emission control regulations promulgated by the Commission and an Air Pollution Control Division is established. Local air pollution control agencies are provided with review and enforcement powers.

(3) Abate pollutant emission on an emergency basis to prevent substantial endangerment to the health of persons, i.e., authority comparable to that available to the Administrator under section 303 of the Act.

The Governor is empowered to declare a state of air pollution emergency whenever a situation develops that endangers the public health, to curtail movement of motor vehicles or order a halt or curtail all operations, activities, processes or conditions that he reasonably believes to be contributing to such an emergency. Injunctive action is also authorized if cease and desist orders issued by the division of administration are not complied with.

> (4) Prevent construction, modification, or operation of a facility, building, structure, or installation, or combination thereof, which directly or indirectly results or may result in emission of any air pollutant at any location which will prevent the attainment or maintenance of a national standard.

It is recommended, as part of the Air Quality Maintenance Plan, that the Colorado Air Pollution Control Act be amended so as to provide the Division of Air Pollution Control the legal authority necessary to comply with this requirement.* Such amendment shall be enacted no later than six months after the acceptance of this Air Quality Maintenance Plan by the Administrator of the United States Environmental Protection Agency.

> (5) Obtain information necessary to determine whether air pollution sources are in compliance with applicable laws, regulations, and standards, including authority to require record keeping and to make inspections and conduct tests of air pollution sources.

The Air Pollution Control Act requires an "air contamination emission notice" to be filed with the Colorado Department of Health prior to the emission of an air contaminant from any facility, process, or activity, except residential structures. An "air contamination emission notice" must also be filed for any facility, process, or activity which is altered and results in an increase in emissions of air pollutants.

The division has the duty to enter and inspect any property, premise, or place, for the purpose of investigating either an actual or a suspected source of air pollution or air contamination or ascertaining compliance or noncompliance with any emission standard or any order under this article.

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*Colorado has enacted an amendment providing for control of indirect sources but it is evidently not sufficient. See Section VI.

(6) Require owners or operators of stationary sources to install, maintain, and use emission monitoring devices and to make periodic reports to the State on the nature and amounts of emissions from such stationary sources; also authority for the State to make such data available to the public as reported and as correlated with any applicable emission standards or limitations.

The Administrator has delegated to Colorado the authority under Section 114 (a)(1)(B) and (C) of the Clean Air Act to require sources within the State to install and maintain monitoring equipment and to report periodically on the nature and amount of their emissions.

LEGAL AUTHORITY FOR LAND USE PLANNING

Recently enacted legislation in Colorado, House Bill No. 1041 (Appendix C), provides for State involvement in matters of State interest regarding land use. This law provides that local governments may designate certain areas (mineral resource areas, natural hazard areas, historical-archaeological-natural interest areas, or areas around key facilities) or certain activities (water and sewage treatment systems, solid waste disposal sites, airports, mass transit facilities, arterial highways and interchanges, new communities, water projects, and nuclear test sites) as being of state interest. Such areas or activities must then be administered by the local government in accordance with either guidelines provided by the legislation or by certain state agencies. Detailed guidelines for administration are to be developed by the local governments. While this law is limited in scope, it has several features of potential importance to air quality maintenance.

The Colorado Land Use Commission may initiate the process of identification, designation, and promulgation of guidelines for matters of state interest. Normally, local agencies must initiate this process, but the Land Use Commission may request the local agency to act. The Land Use Commission also has the power to seek judicial review of local designation actions or guidelines. During such proceedings, development on the area involved is forbidden by statute.

Once a matter of state development is designated, no development involving that area or activity may occur until guidelines are promulgated and until a permit is granted by the local government involved. To grant a permit requires an application and a public hearing. Decisions to grant permits are subject to judicial review. The Land Use Commission or the local government may enjoin actions without proper permits.

The Colorado Department of Local Affairs is to conduct a program to encourage the preparation of inventories of matters of state interest within each county and municipality, by 30 June 1976, as part of comprehensive community plans. Funds have been provided for this planning, and the Department of Local Affairs is authorized to establish standards for the scope, detail and accuracy of the planning. The Land Use Commission is also authorized to assist the counties and municipalities in planning for designation of matters of state interest.

The items to be considered as matters of state interest include several which can markedly influence development patterns and therefore air quality, namely: mineral resource areas, public utilities (water supply systems, sewerage, major facilities for telephone, gas, or electric systems), airports and their surroundings, public transportation facilities and their surroundings, arterial highways and interchanges and areas around them, and new communities.

Some of the legislative guidelines for these matters of state interest will encourage the consideration of air quality in administering them. For areas around key facilities (which includes airports, utility facilities, highway interchanges, and mass transportation facilities) the legislation calls for developing them in a manner that will discourage traffic congestion and will not impose "burdens or deprivation on . . . a region . . ." with only local benefits. Areas around mass transportation facilities are to be developed in conformance with the community master plan. Arterial highways and interchanges and collector highways, and major facilities of public utilities, are to be located in a manner which avoids conflicts with master plans.

In addition, House Bill No. 1041 limits uncontrolled growth patterns by requiring that major extensions of domestic water and sewage treatment systems be permitted only in those areas in which the anticipated growth and development can be accommodated within the "environmental capacity" of the area.

CURRENT EMISSION CONTROL REGULATIONS

As required by Section 66-31-8 of the Colorado Air Pollution Control Act of 1970, the Colorado Air Pollution Control Commission has adopted a number of regulations which stipulate control measures for emission and other measures which help provide for the attainment of the NAAQS. In addition, the Commission has also adopted ambient air standards for suspended particulate matter and sulfur dioxide for the Metropolitan Denver AQCR and the State of Colorado which are more stringent than those promulgated by EPA. A summary of these standards is given in Table 13.

The intent and purpose of these regulations are stated by the Commission to be:

1. To achieve and maintain levels of air quality which will protect human health and safety, prevent injury to plant and animal life, prevent damage to property, prevent unreasonable interference with the public welfare, preserve visibility and protect scenic, aesthetic and historic values of Colorado.
2. To require the use of all available practical methods to reduce, prevent, and control air pollution for the protection of the health, safety, and general welfare of the people of the State of Colorado. In order to achieve air purity consistent with this intent it is necessary,

Table 13. COLORADO AMBIENT AIR STANDARDS FOR SUSPENDED PARTICULATE MATTER AND SULFUR DIOXIDE (MICROGRAMS PER CUBIC METER - $\mu g/m^3$)

Pollutant	Non-designated areas	Metro-Denver Air Quality Control Region, and designated state areas		
		1973	1976	1980
Suspended particulate Matter				
Short term[a]	150	200	180	150
Long term[b]	45	70	55	45
Sulfur dioxide				
One hour level[c]		800 (0.28)	300 (0.10)	
Short term[d]	15 (0.0050)	300 (0.10)	150 (0.050)	55 (0.020)
Long term[b]		60 (0.020)	25 (0.0090)	10 (0.0040)

[a] A 24-hour maximum of any 24-hour period and must not be exceeded more than once in a 12-month period.

[b] An annual arithmetic mean of all 24-hour concentrations.

[c] A 1-hour maximum arithmetic mean in any 24-hour period, and must not be exceeded more than once in any 1-month period.

[d] A 24-hour maximum arithmetic mean of any 24-hour period, and must not be exceeded more than once in a 12-month period.

Note: ( ) = Equivalent values in parts per million.

ultimately, to control air contaminant emissions to such a degree of opacity so that the emissions are no longer visible.

3. To prevent significant degradation of Colorado's air resource.
4. To prevent odors and other air pollution problems which interfere with the comfortable enjoyment of life.
5. To apply the major resources of the Colorado air pollution control programs toward solving priority air pollution problems.

The problem of maintenance of air quality and general environmental degradation is one which has been called by the Colorado Air Pollution Control Commission as an area in which comprehensive, coordinative planning needs to be employed:

> The Commission recognizes that the growth in the amount and complexity of air pollution in Colorado is brought about by and incident to population growth, mobility, increased affluence, industrial development and changing social values in said State. The Commission believes that the air pollution problem is likely to be aggravated and compounded by additional population growth, mobility, affluence, industrial development, and changing social values in the future, which are likely to result in serious potential danger to the public and the environment. Therefore, the Commission intends to pursue solutions, in conjunction with other appropriate agencies and interests, which have a direct interest and capability in solving a growing air pollution problem in relation to the broader environmental degradation problem. It is the intent of the Commission to coordinate with industrial, commercial, agricultural and transportation planning organizations, land use and other environmental organizations, the public, the legislature, educational organizations, and other major interests in such a manner as to prevent air pollution in Colorado.

The regulations on emissions of contaminants to the air vary as to their level of technicality. The control stipulations range from banning of emissions (e.g., open burning) to opacity to process rates. Some of the regulations apply generally to control of particular pollutants from many sources while others apply to specific processes. As one means of ensuring compliance with regulations, a permit system is also provided as well as the regulations for indirect source review promulgated by EPA.

All current regulations are provided in Appendix E and they are briefly summarized and discussed, as they relate to the pollutants of interest, below. Some regulations recently proposed by the Colorado Air Pollution Control Commission are given in Appendix E.

General Review Requirements

Under the Regulation Governing Authority to Construct and Permit to Operate, Regulation No. 3, "no person shall discharge, or cause to be discharged, into the atmosphere any air contaminant if an 'air contaminant notice' " has not been filed. Such air contaminant emission notices specify the location at which the proposed emission will occur, the name and address of the person operating or owning such facility, process, or activity, and an estimate of the quantity and composition of the expected emission.

Regulation No. 3 also requires that any person planning to construct or modify any new air contamination source, either with basic process equipment or air pollution control equipment, receive written authorization from the Air Pollution Control Division. The Division will grant such authorization if:

a. The new air contamination source is so designed and will be constructed or modified to operate without causing a violation of the emission control regulations of the Commission, and any applicable national or local air pollution emission control ordinances and regulations.

b. The new air contamination source is designed, built, and equipped in accordance with the best available practical methods to reduce, prevent, and control air pollution.

c. The new air contamination source, as designed or modified,does not significantly endanger maintenance or attainment of any ambient air quality standards of the Commission, and any more stringent national or local ambient air quality standards.

In addition, a permit to operate any such new air contamination source is required to be granted by the Division before the operation of the equipment. Before a permit to operate is granted, the applicant, if required by the Division, must conduct performance tests in accordance with methods approved by the Division with the tests being made at the expense of the applicant. The Division may monitor such required performance tests conducted by the applicant and may also conduct performance tests. Standards for the granting of a permit to operate are:

a. The emissions of the air contamination source will satisfy the requirements of the emission control regulations of the Commission or any applicable national or local air pollution control ordinances and regulations and has been constructed, installed, or modified in accordance with the requirements and conditions contained in the authority to construct or modify.

b. After January 1, 1975 no existing air contamination source shall be granted a permit to operate unless the Division has determined to its satisfaction that said air contamination source will operate in such a manner so as not to significantly endanger maintenance or attainment of any ambient air quality standards of the Commission, and any more stringent national or local ambient air quality standards.

The Division may impose conditions upon the applicant in the permit to operate which require the owners or operators of air contamination sources to install, maintain, and use instrumentation to monitor and record emission data as a basis for periodic reports to the Division.

Other review requirements have been assumed by EPA due to the disapproval of the state plans. As published in the Code of Federal Regulations (40 CFR 52.22(b)), no construction or modification of designated indirect sources may be commenced after December 31, 1974, unless approval has first been obtained from the Administrator of EPA. Approval will not be given if it is determined that the indirect source will:

(a) Cause a violation of the control strategy of any applicable state implementation plan; or

(b) Delay the attainment of the national standards, for specified pollutants, in any region beyond the specified attainment date; or

(c) Cause a violation of the national standards, for specified pollutants, in any region where the attainment date specified for any such region will have passed at the time of completion of the indirect source.

The Colorado Air Pollution Control Commission, while having no direct regulations for the review of indirect sources, adopted a policy statement on April 26, 1973, resolving:

1. That there be a postponement of the approval of the construction of new freeways in the Denver area (and the enlargement of existing freeways) until it has been demonstrated in environmental impact statements for such freeways that such freeways will not adversely affect air quality (both on a short and long term basis).

2. That any new construction of freeways and other "complex air pollution sources" in the Denver metropolitan area and in other Colorado areas be allowed only when construction of said sources is not likely to endanger the achievement or maintenance of ambient air quality standards.

3. In order to meet Federal ambient air quality standards on schedule, the Commission estimates that a significant decrease of projected vehicle miles traveled will be necessary in the Denver area. The Commission feels that automobile traffic should be discouraged while at the same time less polluting alternate forms of transportation should be encouraged.

4. That the Colorado Legislature recognize the importance of and pass legislation mandating the joint use of Land Use and Transportation planning as necessary tools for the attainment and maintenance of publicly acceptable levels of air quality by granting sufficient powers to appropriate agencies for this purpose.

In addition to these review requirements for construction of indirect sources, the Commission has adopted, as Regulation No. 6, the Standards of Performance for New Stationary Sources (40 CFR 60) as set forth and published in Volume 36, Number 247, Part II of the Federal Register, dated December 23, 1971.

Current Regulations for Particulate Emissions

The Air Quality Implementation Plan for the State of Colorado based its control strategy development for suspended particulates on the highest reported annual geometric mean of 122 $\mu g/m^3$, which occurred in Denver. This value determined required emission reductions of 51 percent and 67 percent to meet the primary and secondary standards, respectively. The reduction of 51 percent was to be achieved in part by the application of Regulation No. 1 with the balance being met by the application of Federal particulate emission control regulations on automobiles and aircraft. Federal regulations directed at controlling particulate emissions from automobiles have not yet been promulgated.

Regulation No. 1, as presented in the SIP, was projected to decrease stationary source particulate emissions in the Metropolitan Denver AQCR (the example region) from 18,096 tons/year in 1970 to 8,425 tons/year in 1975, or a reduction of 46 percent. The control measures imposed to receive this reduction included a general requirement that emissions could not obscure vision to a degree greater than 20 percent opacity, a ban on open burning without a permit, and process rate based regulations for major fuel-burning equipment, refuse-burning equipment, and manufacturing processes. Control of fugitive dust, at the time of the SIP, was based on the 20 percent opacity regulation and the need for five or more complaints. This regulation for fugitive dust has been recently amended and is discussed below.

The reduction of 67 percent to attain the secondary standard was assumed to require emission reductions exceeding those which can be achieved through the application of reasonably available control technology (RACT).

An 18-month extension was therefore requested, and granted by EPA, in order to formulate and submit that portion of the SIP.

In searching for particulate emission sources where additional emission reductions could be demonstrated as part of the plan to achieve the secondary standard, the Colorado Air Pollution Control Commission identified fugitive dust from unpaved roads and other sources as contributors to particulate pollution which were amenable to control. The agency next drafted regulations designed to provide the best control feasible for the fugitive dust sources that they had identified. However, due to lack of available data on (1) emission rates from these sources and (2) the effectiveness of the proposed regulations in reducing particulate emissions, the Commission was unable to quantitatively demonstrate that the fugitive dust controls would result in the necessary reduction in emissions.

To compound this problem of presentation, measured particulate levels at some sampling sites were increasing with time, rather than decreasing according to the projections of the initial implementation plan. This divergence of actual measurements from projections indicated that the emission inventory on which the control strategy was based did not account for all emission sources affecting the samplers.

A study was thus undertaken to quantify the reduction in fugitive dust emissions that can be expected from enforcement of the proposed regulations and to estimate the resulting air quality in three Colorado Air Quality Control Regions with these regulations in addition to existing control regulations.

The emission inventory showed that unpaved roads were the largest source of particulate, with agriculture being the second largest, these two sources accounting for 36 and 34 percent, respectively, of the particulate emissions inventoried. The other seven fugitive dust categories--sanded paved roads (for snow control), land development, building construction, highway construction, quarrying/mining, aggregate storage, and cattle feedlots--also contributed significant emissions on a regional basis, so that fugitive dust was responsible for 70 percent of particulate emissions in the Metro-Denver AQCR and 97 percent in the Pawnee AQCR.

Existing Colorado control regulations for particulate emissions from fuel combustion, processes, and other sources were reviewed to determine whether additional emission reductions could be obtained from these sources. Generally, it was concluded that these regulations represent the best available technology, and no significant improvements could be epxected over these allowable emission rates.

Three recommendations were made in an effort to increase the emission reductions attributable to the proposed fugitive dust regulations:

1. Control plans should be required for all unpaved road segments with traffic densities greater than 20 vehicles/hour, instead of the proposed 30 vehicles/hour on road segments greater than one-half mile long;
2. The requirements for submitting a control plan should be modified to insure that all land developments with unpaved roads must submit a plan; and
3. A program should be instituted for the more rapid and more complete removal of sand from streets and highways following its application for snow control.

In response to these recommendations, the Colorado Air Pollution Control Commission has adopted the following measures for unpaved roads in all problem areas:

1. Dust control of all roads in new developments and all new parking lots of over 165 vehicles per day traffic.
2. Paving of existing roads under a plan and time schedule prepared by County and City authorities with maximum available funds for that purpose, the plans to be approved by the Division; and
3. Maximum traffic counts to serve as a guide in determining paving priorities.

Road paving is expensive, amounting to about $20,000 a mile for minimum width two-lane roads. Much testimony has been collected by the Commission on the limitation of highway user funds and other revenues to pave the thousands of miles of roads in Colorado air basins. The Commission's plan calls for maximum possible paving with available funds. The Commission also recognizes increasing difficulty to acquire asphalt for paving with the recent shortages in petroleum products.

The regulations of the Commission require, on a case-by-case basis, review of all development plans of over 5 acres in the critical air pollution areas. Additionally, the Commission will consider smaller increments of road cutting, and requirements for road surfacing, and revegetation and surface treatment. Watering for dust suppression will be required where water is available. Inherently, earth-moving activities are dusty, especially where subsurface moisture content is low as in much of the southwest United States. Control beyond that adopted by the Commission would most likely severely inhibit land development and construction activities, an alternative having serious economic implications. It is the Commission's intent to deny permits only to those development and construction plans which fail to employ all reasonably available air pollution controls as provided from time to time in Commission regulations and policy.

Regarding the sand on paved roads, the Commission seriously doubts the estimate that a 25% reduction of emissions is possible by picking up sand sooner. The state Department of Highways and Denver County Department of Highways have informed the Colorado Air Pollution Control Division that, in their opinion:

1. The sands used are 1/4 inch diameter material on down in size to very fine material;
2. The sands are mostly comprised of river-run material and decomposed granite and that;
3. Road crews are removing sand off the streets as soon as possible now without endangering the flow of traffic.

Assuming this information to be correct, eliminating or significantly reducing street sanding would appear to risk human injury and cause property damage problems, out of proportion to the air pollution benefits.

The recently promulgated regulation regarding control of fugitive dust (amended Section II-D, Regulation No. 1) is provided in Appendix E and summarized, with control efficiencies discussed, in Section III.

However, even with these additional provisions, it is still doubtful that the secondary standards will be achieved in the AQMSA. The major problems in achieving the standards are the large contribution of fugitive dust to total particulate emissions in the regions and the low control efficiencies attainable for most fugitive dust sources. In fact the Federal secondary particulate standard of 150 $\mu g/m^3$ (24 hour) is exceeded on almost completely undeveloped areas. The high winds in these semi-arid areas of sparse vegetation are the cause of the violation of standards due to their uplifting action on the dusty ground cover.

Therefore, the Commission recommended to EPA, in the Colorado Plan for Federal Secondary Ambient Air Quality Standards, that when wind speeds exceed 30 mph those situations be exempt from meeting the secondary particulate matter standard. The Commission concurred with the use of annual geometric mean data as a more reasonable basis for a control plan, but nevertheless felt meeting the Federal Secondary Standard would have a devastating effect upon the state.

Current Regulations for Carbon Monoxide Emissions

The discussion of control strategies for carbon monoxide in the Colorado SIP was based on the second highest 8-hour concentration, measured at the Denver CAMP station and reported as 21.0 mg/m^3 (18.3 ppm), which implied an emission reduction of 52 percent would be required in order to meet the national primary and secondary ambient air quality standard of 10 mg/m^3 (9 ppm) carbon monoxide (8-hour average). Application of the

Federal emission control regulations for carbon monoxide was assumed to provide a 23 percent reduction by 1975. Nonmotor vehicle emissions amounted to 3 percent and were not considered to help achieve the reduction required. Since the additional 29 percent reduction was determined to be achievable only with extreme hardships, as per section 420.30 of the Federal Register, Volume 36, No. 158, a 2-year extension was requested in order to benefit from the additional degree of Federal automotive control during the period 1975 to 1977.* The expected improvement in air quality in 1977 as the result of Federal automotive controls was 44 percent. Because this was still insufficient for the attainment of the standard, it was proposed to promote the formation of carpools and reserved bus lanes and to have the State Air Pollution Control Commission publicly oppose any additional large scale parking facilities in the downtown Denver area. In addition, the implementation of an annual emission testing program was planned. Such a combination of strategies appeared at that time to provide a 63 percent emission reduction for carbon monoxide; however, it was necessary to do further evaluation of possible control measures.

On January 31, 1973, the U.S. Court of Appeals for the District of Columbia Circuit ordered EPA to approve or disapprove state transportation control plans no later than June 15, 1973. Further, a period of public comment was required after receiving the plan before EPA could approve a state's plan. Since the Governor of the State of Colorado originally submitted the "State of Colorado Air Pollution Control Transportation and Land Use Plan" on June 4, 1973, EPA had to publish notice of disapproval of the plan in the June 22, 1973, Federal Register. This disapproval was based only upon the lack of timely submittal.

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*EPA granted a 2-year extension for meeting the CO standard, in the Denver AQCR only. See 40 CFR 52.322.

A review of the Colorado plan revealed several deficiencies and EPA requested supplemental information. This supplemental information was submitted by the Governor on July 16, 1973. The plan as finally submitted was comprised of the following strategies:

1. Semiannual inspection and maintenance program using the idle test mode to be fully implemented by December 1, 1975.
2. Air bleed retrofit for pre-1968 vehicles to be fully implemented by July 1, 1976.
3. High altitude modification and tuning specifications for 1968-1975 vehicles to be fully implemented by July 1, 1976.

as well as the following strategies to be implemented by December 1, 1974:

4. Designation of mandatory bus/carpool lanes.
5. Limitation on the construction of future parking facilities.
6. Removal of on-street parking in the Central Business District (CBD).

The state also included improvements in public transit and expanded bikeway development and use to reduce the number of vehicle miles traveled.

EPA's review of this plan showed that additional measures were necessary to achieve the national ambient air quality standards for carbon monoxide and photochemical oxidants, and the following measures were proposed in the August 2, 1973, Federal Register to meet this requirement:

7. A limitation on gasoline sales at fiscal year 1973 levels to be effective on July 1, 1974.
8. A further limitation on gasoline sales beginning May 31, 1977 adequate to ensure achievement of the standards, the extent of this additional limitation to be estimated by the State by January 1, 1977.

EPA held a public hearing on September 10 and 11, 1973, in Denver on the proposed regulations, and also evaluated written comments and supplemental information. On November 7, 1973, the Administrator published his approval and promulgation of a Colorado Transportation Control Plan (TCP) in the Federal Register (Appendix C). Summarizing this action,

- Strategies 1 through 6 were approved as submitted.
- The regulations proposed by the State of Colorado for the control of hydrocarbon emissions from stationary sources were disapproved and the regulations on stationary hydrocarbon sources proposed in the August 2, 1973 Federal Register were promulgated.
- Gasoline sales limitations were promulgated on a contingency basis, adequate to ensure attainment of the standards by May 31, 1977.

The administrator also granted at that time the extension of time until May 31, 1977 to achieve the ambient air quality standards, as requested by the Governor of Colorado.

In the course of preparation of the TCP, the Colorado APCC determined that the actual reduction in CO emissions from the 1971 levels needed to attain the National Ambient Air Quality Standard for carbon monoxide was 64 percent. The TCP, as promulgated by EPA, was expected to reduce CO emissions by an additional 33 percent compared to 1971 emissions beyond the 31 percent reduction determined by EPA to be due to the Federal Motor Vehicle Control Program. This reduction was due, in part, to the assumption of a 15 percent reduction in VMT in the metropolitan area in 1977; however, without gasoline restrictions these VMT-reduction strategies accounted for only a 6 percent reduction from the 1971 emissions of carbon monoxide.

Regulations have not yet been issued by the Colorado Air Pollution Control Commission for complete implementation of the mobile source control measures in the TCP. Work is at present underway to finalize the inspection, maintenance, and retrofit programs. Regulations have been passed and planning is in progress for the bus/carpool lanes, parking facility limitations, and employer programs to encourage use of transit and bicycles. Expansion of transit service is underway, with a major bus acquisition by the Regional Transportation District (RTD) being supported by the U.S. Urban Mass Transportation Administration. To monitor the effectiveness of the TCP at reducing VMT, Colorado has also prepared and submitted to EPA on June 17, 1974, a program for continuous, remote monitoring of traffic in the Denver area. This monitoring plan was required by EPA.

The Federal Motor Vehicle Control Program (FMVCP) - As the FMVCP emission standards for all new motor vehicles are being relied upon heavily in this, and other, transportation control plans, it deserves some discussion at this point.

The Clean Air Act as amended requires that new light-duty 1977 model-year motor vehicles achieve 90 percent reduction of carbon monoxide and hydrocarbon emissions compared to 1970 model-year vehicles and that 1978 model-year vehicles achieve, in addition, a 90 percent reduction of nitrogen oxides compared to 1971 vehicle emissions. The driving cycle for testing the 1972 through 1974 model-year vehicles has been modified for 1975-1976 certification to include hot as well as cold starts to better represent driving patterns in areas where high pollution levels occur. These deadlines for 1977-1978 standards may be extended by one year by the Administrator of EPA if needed technology is deemed not to be available for a sufficient time to meet production deadlines. Federal emission standards for heavy duty vehicles (greater than 6,000 pounds gross vehicle weight) were first implemented for the 1970 model year. Heavy-duty gasoline engines were limited to 275 ppm hydrocarbons and 1.5 percent carbon monoxide, and heavy-duty diesel smoke plume emissions were limited. Beginning with the 1974 model year, all heavy-duty vehicle engines (both gasoline and diesel) are limited to 16 grams per brake horsepower-hour of hydrocarbons plus nitrogen oxides and 40 grams per brake horsepower-hour of carbon monoxide. In addition, diesel heavy-duty engines are limited to certain smoke opacities. (More restrictive emission standards have not yet been established for later model years of heavy-duty engines.)

EPA estimated that almost one-half the total emission reduction over 1971 base year levels in Denver required to meet ambient air quality standards in 1977 will be achieved through FMVCP (31 percent out of the required 64 percent reduction for CO, and 23 percent out of the required 60 percent reduction for HC). The assumptions implicit to these estimates are that required control technology will be available and in adequate supply for mass production, and a replacement of existing, relatively high-polluting vehicles by newer, lower-polluting vehicles through normal attrition will occur, gradually reducing the average emission rate of the passenger car population. The potential physical environmental effect of the FMVCP, therefore, is to substantially reduce air pollutant emissions thereby enhancing air quality, but not to the degree necessary to meet ambient health and welfare standards by 1977. Therefore the other control measures presented must also be implemented.

Current Regulations for Hydrocarbon Emissions

The required hydrocarbon emission reduction, a function of photochemical oxidant concentration, as determined in the Colorado SIP, was based on the maximum measured 1-hour photochemical oxidant concentration at the Denver CAMP station of 294 $\mu g/m^3$. This implied a needed reduction of 48 percent in hydrocarbon emissions would be required in order to meet the national primary and secondary ambient air quality standard of 160 $\mu g/m^3$ photochemical oxidant. Application of the Federal emission control regulations for hydrocarbons was expected to provide a 44 percent reduction by 1977. An additional reduction of 13 percent was expected by the establishment and operation of an emission testing program. Later review of the air quality data determined that a 60 percent reduction in hydrocarbon emissions from the 1971 level was actually necessary for the attainment of the photochemical oxidant standard by 1977.

At the time that the transportation control plan was being evaluated, EPA proposed a comprehensive set of regulations for the control of hydrocarbon emissions from stationary sources (to replace those proposed by the state). These are also given in Appendix C. These regulations, along with the other components of the TCP discussed above, are expected to reduce hydrocarbon emissions in 1977 to 40 percent below the 1971 level. An additional reduction of 23 percent is assumed by EPA to occur as the result of the FMVCP. Out of the 40 percent reduction, the VMT-reduction measures account for 5 percent and the stationary hydrocarbon controls provide a 24 percent reduction; the remainder comes from tailpipe controls and gasoline restrictions.

The Colorado Air Pollution Control Commission adopted, September 13, 1973, Regulation No. 7 to control the emissions of hydrocarbon vapors from stationary sources, effective November 28, 1973. These regulations require controls for petroleum product storage, petroleum distillate loading, water separation from petroleum products, pumps and compressors, waste gas disposal, organic solvents, disposal and evaporation of solvents, dry cleaning solvents, and degreasing operations. This regulation has not yet been reviewed by EPA to determine whether it is approvable.

Current Regulations for Nitrogen Oxide Emissions

The Air Quality Implementation Plan demonstrated that, given the current concentration of nitrogen oxides, measured in the Denver area at the National Air Sampling Network (NASN) station to be 68 $\mu g/m^3$ (annual arithmetic mean), no controls are needed for the attainment of the primary and secondary standard of 100 $\mu g/m^3$ (0.055 ppm). Any projected reduction in nitrogen oxide emissions due to the TCP or the FMVCP is discussed in Section IV.

Current Regulations for Sulfur Dioxide Emissions

The Federal Register of September 14, 1973 (Vol. 38, No. 178), sets forth the revised secondary ambient air standard for sulfur dioxide. The amendments revoke the annual National Secondary Ambient Air Quality Standard for sulfur dioxide, which was 60 micrograms per cubic meter (0.02 ppm). In addition, the amendments delete the maximum 24-hour concentration of 260 micrograms per cubic meter (0.1 ppm). The secondary 3-hour standard, a maximum concentration of 1300 micrograms per cubic meter (0.5 ppm) not to be exceeded more than once per year, remains in effect.

In the Denver Air Quality Control Region, sulfur dioxide as measured at CAMP station since January, 1969, has not exceeded 0.30 ppm in any 3-hour average--well below the secondary 3-hour standard. There is therefore no current need for control regulations to ensure attainment of standards.

However, Regulation No. 1 does contain a section on the control of sulfur dioxide emissions. Section III sets limits on the concentration of sulfur dioxide in the emissions from process units. For the purpose of this regulation, all oxidized forms of sulfur (including, but not restricted to, SO_3, $SOCl_2$, and H_2SO_4 mist) are considered as sulfur dioxide. This regulation provides some aid in the maintenance of air quality as it relates to sulfur dioxide.

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SECTION III

EMISSION ALLOCATION AND PROJECTION METHODOLOGY

PROJECTION BASIS

This section summarizes those procedures used for the allocation and projection of emissions in the Denver AQMSA. A more detailed discussion of these methodologies can be found in the appendices. The only pollutant for which allocation (beyond that obtained from readily available sources) needed to be performed was particulate matter; and, among the sources of particulate matter, fugitive dust sources received appreciable attention. Growth rates were derived for point and area sources.

The basis for the data used for the projection of air quality is crucial to the determination of air quality attainment and maintenance measures. Unfortunately, no standard criteria exist for data selection. Since the creation of any set of projections entails certain assumptions as to future conditions, it is essential to investigate these assumptions to determine their degree of reasonableness and to call out these assumptions as the foundation of the air quality maintenance plan upon which any additional restrictions are to be built. These assumptions must be integrated into the maintenance plan which is presented in Section VI.

For the Denver metropolitan area, the best available basis for projecting emissions was the Denver Regional Council of Governments' projections of socioeconomic growth for the Joint Regional Planning Program area. These growth projections provided the most detailed data base and compilation of growth of various population, employment, land-use, and transportation parameters.

The use of this data is a reasonable approach to the determination of the growth of the Denver region as the Denver Regional Council of Governments is the development commission for this area and will be instrumental in directing the growth of the region along these lines if no additional controls are imposed due to the need for air quality maintenance. The implication of the use of this data is that in the estimates there are certain implicit assumptions concerning transportation facilities, population size and distribution, and the existence of certain highway networks.

For areas outside of the JRPP, official state projections were available up to 1980, and linear extrapolation was performed to estimate 1985 parameters.

POINT SOURCE EMISSIONS

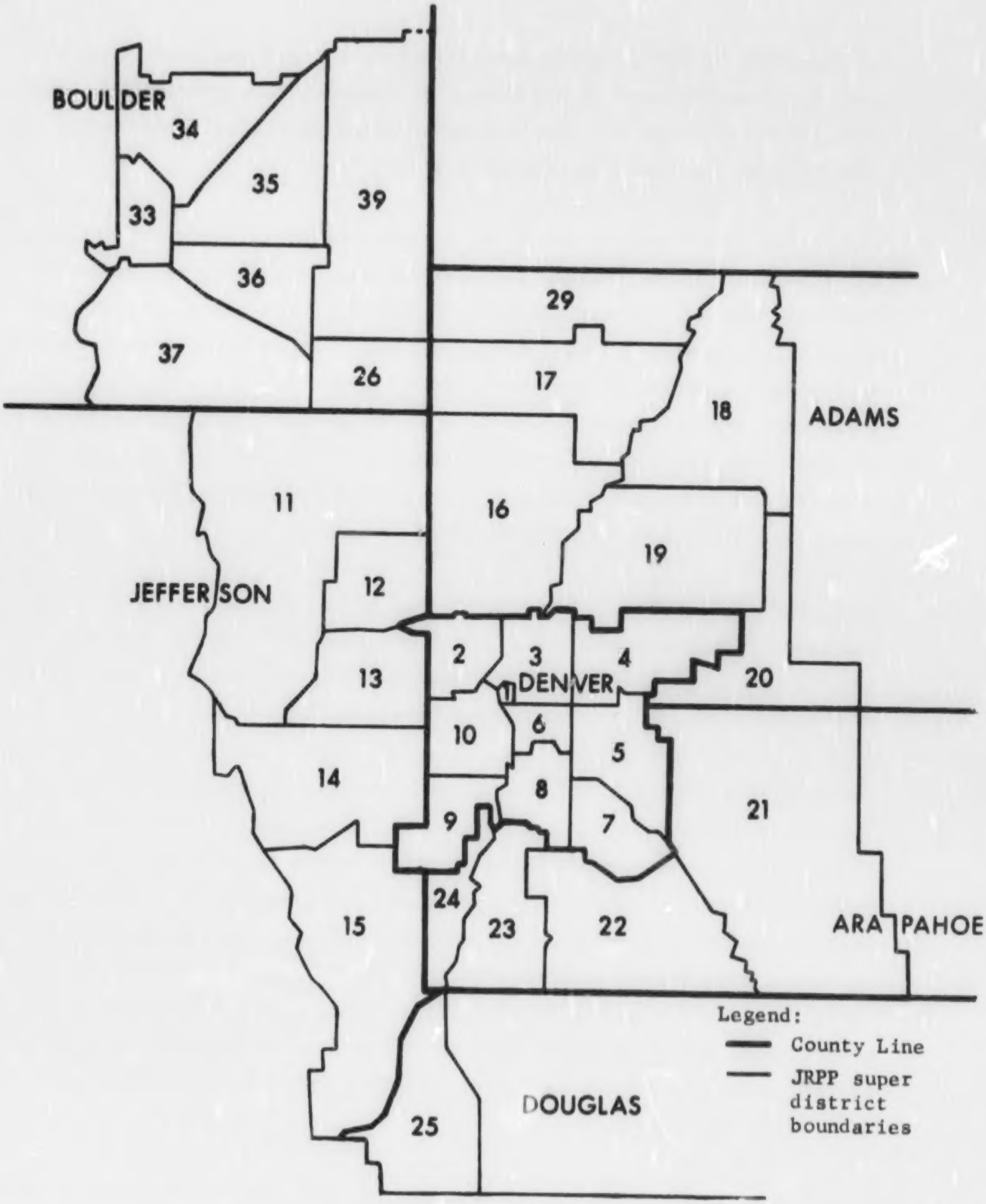
As point source emissions coordinates are already given in the National Emissions Data System (NEDS), it is not necessary to do any significant further allocation of point sources; however, some generalized allocation assumptions are made in the development of projection parameters. These are summarized below and detailed in Appendix G. Sufficient information is not immediately available to allow for any allocation of projected emissions so projections are assumed to apply to the location of existing sources.

Projections of particulate emissions from point sources are derived from a review of regulations controlling these emissions, as given in the Air Quality Implementation Plan for the State of Colorado, and regional forecasts of economic growth during the period of interest. Initial projection of the 1972 NEDS emissions data to 1975 emission levels is accomplished by applying the regulations to the process rates (for all sources producing more than 100 tons per year). This provides the maximum estimated level of emissions under existing control constraints and sets 1975 as the base year for projections.

Within the Denver metropolitan and surrounding areas, data is available for sub-county areas (Figure 21), called super districts by the Joint Regional Planning Program (JRPP); the data includes past, current, and expected employment by major industry types. It is assumed that the percentage of pollution from each industry type which occurs in each super district is directly proportional to the percentage of employment for that industry type within that super district and that the growth of pollution from each industry is equal to the economic growth or, in this case, the employment growth rates.

Under these assumptions, through the use of the employment data, it is possible to allocate emissions from the county-wide area to the smaller super districts. The emission allocations for point sources are, at the same time, divided into commercial-institutional and industrial sectors within each super district, using the JRPP data. Employment growth rate factors are calculated for each super district, on the same basis, and applied to the emissions to give expected emissions in 1980, 1985, and 1990. Then, combining the emissions from each source sector, for each year, and dividing by the total point source emissions from these sectors in the base year, a weighted average growth factor for the point source emissions within each super district is determined. No additional controls, such as New Source Performance Standards, are assumed in these projections due to the high level of control for existing sources under state regulations in the base year and the fact that new source contributions will be minimal.

Growth rate factors for non-urban areas of each county, portions of which are in the JRPP area, are determined by assuming a slightly higher growth


BOULDER
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ADAMS
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JEFFERSON
12
2
3
4
DENVER
13
20
10
6
5
14
8
21
9
7
24
15
23
22
ARAPAHOE
25
DOUGLAS
Legend:
County Line
JRPP super district boundaries

Figure 21. Six county JRPP area - by super districts

rate than found in the most rural of the JRPP super districts within each county. Such an assumption provides a liberal estimate of growth for a small percentage of the economic activity within that county. Counties within the metropolitan Denver AQCR, but not containing any JRPP areas, are assigned emission growth rates equal to the OBERS economic growth rates projected for the whole AQCR. Larimer and Weld Counties are assigned emission growth rates slightly higher than projected by OBERS for the Pawnee AQCR. All of these growth rates are presented in Table 14.

Point source emissions of carbon monoxide are negligible in comparison with those from motor vehicles and are therefore assumed to be constant throughout this period. Hydrocarbon emissions from point sources are, however, significant within the area of interest. Some reductions in emission levels do occur at point sources due to Federal regulations (40 CFR 52, Subpart G - see Appendix C) and these are considered in the discussion of these regulations given under the heading of hydrocarbons in Section IV.

The growth rate for nitrogen oxides is broken down by power plant, industrial, commercial-institutional and residential sectors and is only calculated for the metropolitan Denver area as a whole. The growth rates derived are simply those of employment or population increase in the various sectors. For 1975 to 1985, the growth rate is assumed to be 1.0 for power plants, 1.4 for industrial sources, 1.35 for commercial-institutional sources, and 1.4 for residential related sources. The intervening years were assumed to have emissions based on a linear interpolation.

MOBILE SOURCE EMISSIONS

Emission densities for CO, HC, and NO_x were derived from the projected traffic data for 1975, 1980, and 1985. In addition CO emissions were

Table 14. POINT SOURCE GROWTH RATES FOR PARTICULATE EMISSIONS (BASEYEAR 1975)[a]

County	Area	1980	1985	1990
Denver	SD1	0.997	0.924	0.850
	SD2	1.078	1.085	1.167
	SD3	1.090	1.156	1.223
	SD4	1.131	1.258	1.386
	SD5	1.130	1.363	1.597
	SD6	1.004	1.006	1.018
	SD7	1.067	1.114	1.161
	SD8	1.075	1.121	1.169
	SD9	1.144	1.266	1.391
	SD10	1.099	1.168	1.237
Jefferson	SD11	1.206	1.439	1.673
	SD12	1.159	1.314	1.469
	SD13	1.001	1.024	1.047
	SD14	1.282	1.563	1.843
	SD15	1.558	2.081	2.604
	Rural	1.565	2.087	2.565
Adams	SD16	1.138	1.264	1.390
	SD17	1.224	1.197	1.170
	SD18	1.382	1.521	1.660
	SD19	1.220	1.459	1.697
	SD20	1.159	1.520	1.306
	SD29	1.992	2.093	2.194
	Rural	1.348	1.478	1.609
Arapahoe	SD21	1.237	1.425	1.613
	SD22	1.538	1.786	2.034
	SD23	1.745	1.143	1.199
	SD24	1.223	1.474	1.726
	Rural	1.546	1.772	2.046
Boulder	SD26	1.182	1.359	1.592
	SD33	1.133	1.271	1.409
	SD34	1.191	1.302	1.413
	SD35	1.190	1.267	1.345
	SD36	1.217	1.449	1.682
	SD37	1.291	1.360	1.430
	SD38	1.186	1.339	1.492
	SD39	1.640	1.940	2.240
	Rural	1.586	1.897	2.172

Table 14 (continued). POINT SOURCE GROWTH RATES FOR PARTICULATE EMISSIONS (BASEYEAR 1975)[a]

County	Area	1980	1985	1990
Larimer		1.194	1.748	1.824
Weld		1.194	1.748	1.824
Gilpin		1.208	1.5	1.833
Clear Creek		1.208	1.5	1.833
Douglas		1.208	1.5	1.833

[a] Based on calculations in Appendix G.

calculated on a yearly basis from 1971 through 1990 for the core and central areas mentioned in the TRW report.[1] As defined in the TRW study, the "Central Area" is a 12 square mile analysis area which lies to the south of 52nd Avenue, one-half mile north of interstate 70 and to the east of interstate 25 as far as Colorado Boulevard. The "Core Area" consists of three square miles and is bounded by Larimer Street on the northwest, 20th Street and 20th Avenue on the north, Logan Street on the east, 13th Avenue on the south, and Speed Boulevard on the west. HC and NO_x emissions for the entire 960 mi^2 Air Pollution Research Advisory Committee (APRAC) Denver Metropolitan Area[2] were also computed for each year for comparison with stationary source emissions within the same region.

The Research and Special Studies Branch of the Colorado Division of Highways provided average values of vehicle-miles traveled (VMT) per day for an array of 240 grid squares each two miles on a side covering the Denver metropolitan area. This information was originally in the form of link data suitable for input to the APRAC-1A program for hourly calculation of CO concentrations at different points within the city for various meteorological conditions. The transformation of vehicle-miles traveled (VMT) from the link format to the grid cell basis was carried out by the Division of Highways so that the data would be more suitable for the application of a rollback technique. For each cell the VMT data was broken down according to the following road type classification and corresponding vehicle speed:

Road Classification	Speed (mi/hr)
Freeway	40
Expressway	34
Primary Arterial	26
Minor Arterial	23
Collector	21
Centroid Connector	20
Ramps	20
Major Arterial	23

The speeds for the Centroid Connector and Ramp road types are rough estimates because these two classes were allocated solely to the secondary emissions category in the APRAC-1A data set.

The basis for the traffic data used in the emission calculations is an origin-destination survey and travel forecast[3] carried out under the Joint Regional Planning Program (JRPP). The output of this study was an estimate of traffic volumes for the current highway network (1972) and projection of traffic and new roads for the year 2000. The VMT data for the intervening years was found by simple linear interpolation.

The emissions of CO, HC, and NO_x for each grid square were then calculated by use of the Kircher and Armstrong emission factors[4] along with diesel emission estimates from AP-42.[5,6] This procedure involves a summation over low mileage emission factors, emission control deterioration, weighted annual travel, and different speed types. Evaporative hydrocarbon emissions were also accounted for in the calculation. Modifications were made in the emission and deterioration factors to account for the fact that high altitude emissions standards will first apply to 1977 model year vehicles and that the interim standards are assumed to be extended through the 1977 model year. The model year distribution and breakdown by vehicle type (light duty, heavy duty, and diesel) were taken from the TRW transportation study for the Denver area.[1]

Projections of mobile source emissions were also carried out for Boulder, Ft. Collins, and Greeley based upon 1968 and 1990 VMT data as a function of road type as listed in the Classification, Needs, and Fiscal Study[7] prepared for the Department of Highways by Wilbur Smith and Associates. To obtain a reasonably accurate measure of the emission density the effective emission areas for these cities were chosen so as to include a significant fraction of the heavily traveled streets but omit the largely rural sections included within the urban boundaries.

Emission density maps were generated and are used for projecting the air quality. These maps are presented in Section IV under the discussion of the corresponding pollutant.

NEDS AREA SOURCE EMISSIONS

Area source emissions of particulates, provided by the NEDS, are projected to 1975, 1980, and 1985 on much the same basis as particulate point sources; however, no regulations can be applied to these sources to provide an initial decrease in emissions. Therefore, a base year of 1972 (the base for the NEDS) is used for projecting particulate emissions from this sector.

In addition to employment statistics, population is used to allocate and project emissions from the residential sector. The employment and population percentages are, again, applied to allocate emissions to super districts and rural regions. Employment and population growth rates are then applied to give projected emissions which are recombined to give total emissions and therefore the growth rate for particulate emissions from stationary sources.

As the percentage contribution from motor vehicles to the total particulates due to the area source sectors is not small, ranging from 13 percent in Denver to 21 percent in Adams and Arapahoe, it is necessary to consider increased emissions from motor vehicles separately. However, since this is still not the majority of particulate emissions, for the purpose of projecting particulates, motor vehicles are included under area sources. (For hydrocarbons, carbon monoxide, and nitrogen oxides, motor vehicles are considered as discussed in the previous subsection.) Projections of increased particulate emissions as a result of motor vehicles are made by assuming that the total emissions from the motor vehicles grow with the increased VMT. While this would normally be a direct proportion, the installation of catalytic mufflers in new cars decreases the emissions from motor vehicles exhaust so that the increase is correspondingly less until all cars are assumed to have catalytic converters. These growth rates for emissions from motor vehicles are then combined with those from the stationary area sources to provide the estimated growth rates for particulate emissions due to all area sources. These rates are presented in Table 15 and developed in more detail in Appendix H.

Projections of increased emissions of carbon monoxide and nitrogen oxides due to stationary sources are not considered due to the minimal impact which area sources are known to have on the ambient concentration. Hydrocarbon emissions from all stationary sources are assumed to decrease as projected under the Federal regulation cited earlier. This is discussed in more detail in Section IV.

FUGITIVE DUST EMISSIONS

Fugitive dust is defined as those particulate emissions arising from certain manmade sources during arid or windy conditions. These sources, as identified in the PEDCo report,[8] include the following:

1. unpaved roads
2. sand on paved roads
3. agriculture
4. land development
5. residential, industrial, and commercial construction
6. highway construction
7. quarrying, mining, and tailings
8. aggregate storage
9. cattle feedlots.

The PEDCo study provided fugitive dust totals by county for Colorado. These figures are here disaggregated into county subunits, or zones. State land use maps were used as a guide in determining zones, so that each zone represents a specific land use. Most of the allocation is directed toward separating agricultural sources and the contributions from sanding of paved roads. Fugitive dust from agricultural operations for a given county is assigned to crop-lands. A similar methodology is applied to the emissions from the sanding of paved roads, with the fugitive dust being distributed to urban areas only. The remaining fugitive dust, principally from dirt roads and construction, is uniformly allocated throughout each county. The specific zones are shown on the maps in Figures 22 and 23 and the corresponding emission densities are given in Table 16. Primary data and calculations for the allocation of fugitive dust are given in Appendix I.

The fugitive dust emissions are projected to 1975, 1980, and 1985 by applying the regulation recently promulgated by the Colorado Air Pollution Control Commission and projected travel and socioeconomic activity. The regulation, Section II-D of Regulation Number 1, is provided in full in Appendix E and is summarized below.

1. A general statewide requirement is that no fugitive dust be emitted which exceeds 20 percent visible opacity or which is visible after it leaves the property of the owner of the emission source. Certain activities, such as agriculture, are exempted.
2. Within the Priority I portions of Air Quality Control Regions only (see Figure 24), which includes only a portion of the AQMSA, specific requirements are established for control of dust from:
    a. All new unpaved roads and parking areas with traffic volumes of 165 vehicles per day (vpd) or more.
    b. Existing privately owned roads and parking areas with 165 vpd or more.
    c. Existing publicly owned roads and parking areas with 165 vpd or more, but with controls only to the extent allowed by financial resources.
    d. Land development, construction, demolition, and related activities.
3. Specific control requirements, statewide, on open mining activities.
4. Where specific requirements for controls are provided, a requirement that permits be obtained and a requirement that specified types of abatement and preventive measures be identified in the permit and utilized.

Table 15. AREA SOURCE GROWTH RATES FOR PARTICULATE EMISSIONS (BASEYEAR 1972)[a]

County	Area	1975	1980	1985	1990
Denver	SD1	1.049	1.100	1.114	1.138
	SD2	1.071	1.179	1.248	1.320
	SD3	1.184	1.185	1.281	1.386
	SD4	1.102	1.241	1.368	1.512
	SD5	1.104	1.240	1.408	1.584
	SD6	1.055	1.113	1.177	1.257
	SD7	1.088	1.198	1.294	1.401
	SD8	1.082	1.180	1.267	1.364
	SD9	1.102	1.238	1.343	1.463
	SD10	1.087	1.194	1.289	1.395
Jefferson	SD11	1.145	1.331	1.549	1.794
	SD12	1.124	1.278	1.409	1.563
	SD13	1.055	1.102	1.170	1.261
	SD14	1.187	1.438	1.668	1.928
	SD15	1.428	2.055	2.703	3.394
	Rural	1.458	2.067	2.676	3.329
Adams	SD16	1.110	1.229	1.338	1.493
	SD17	1.248	1.579	1.922	1.922
	SD18	1.278	1.564	1.660	1.819
	SD19	1.122	1.259	1.414	1.609
	SD20	1.122	1.238	1.391	1.582
	SD29	2.083	3.029	3.776	3.975
	Rural	1.364	1.584	1.673	1.742
Arapahoe	SD21	1.149	1.326	1.485	1.686
	SD22	1.380	1.911	2.163	2.476
	SD23	1.069	1.124	1.175	1.261
	SD24	1.115	1.242	1.375	1.549
	Rural	1.513	2.250	2.361	2.542
Boulder	SD26	1.154	1.355	1.591	1.887
	SD33	1.092	1.197	1.315	1.458
	SD34	1.213	1.170	1.282	1.418
	SD35	1.129	1.290	1.374	1.485
	SD36	1.133	1.301	1.494	1.715
	SD37	1.216	1.514	1.595	1.696
	SD38	1.117	1.259	1.395	1.554
	SD39	1.499	2.238	2.581	2.969
	Rural	1.539	2.216	2.530	2.892

Table 15 (continued). AREA SOURCE GROWTH RATES FOR PARTICULATE EMISSIONS (BASEYEAR 1972)[a]

County	Area	1975	1980	1985	1990
Larimer		1.165	1.485	1.851	2.617
Weld		1.132	1.382	1.695	2.008
Gilpin		1.133	1.390	1.683	1.976
Clear Creek		1.120	1.591	2.043	2.494
Douglas		1.230	1.738	2.382	3.026

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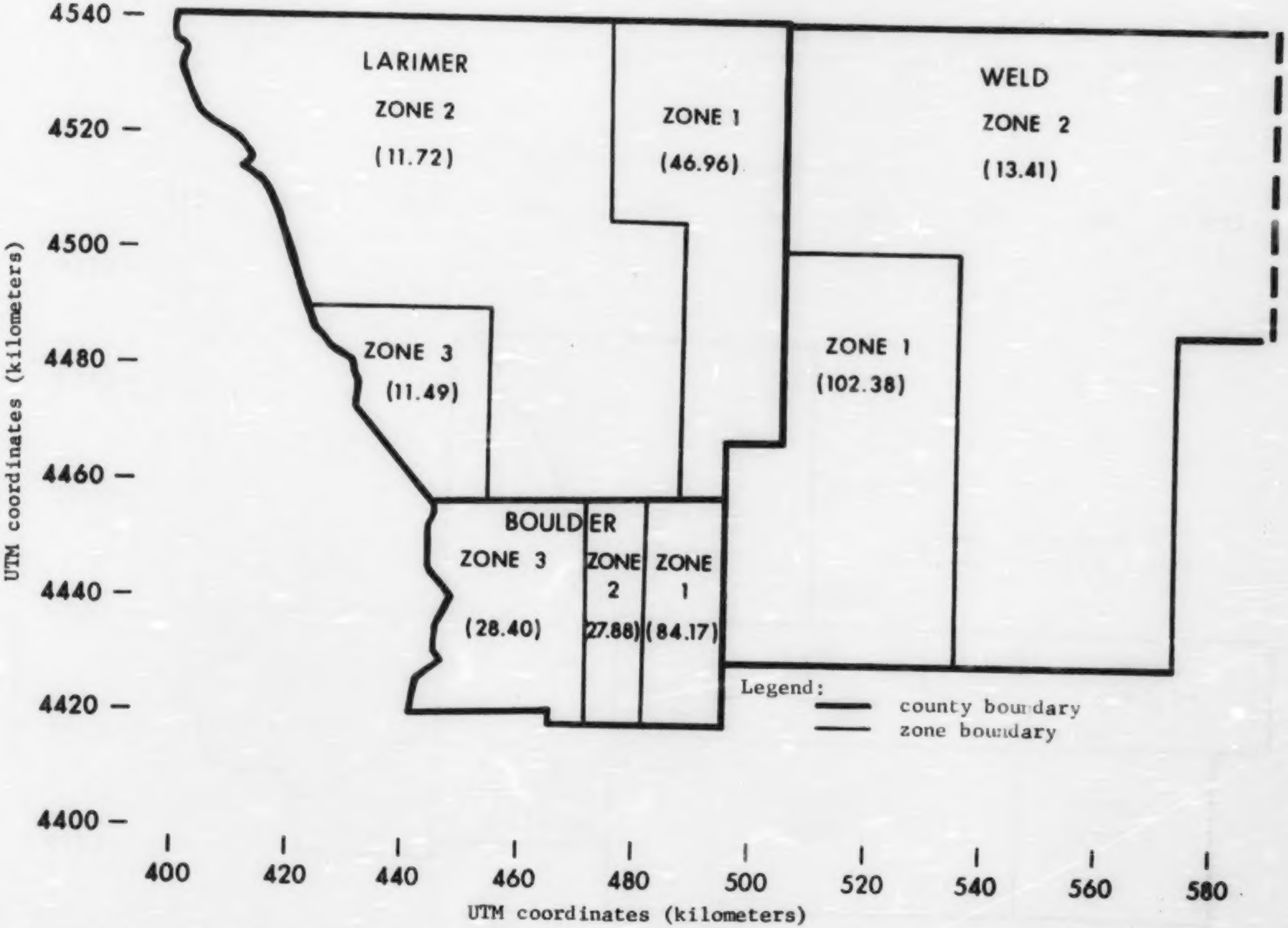
[a] Based on calculation in Appendix H.


LARIMER
ZONE 2
(11.72)
ZONE 3
(11.49)
ZONE 1
(46.96)
WELD
ZONE 2
(13.41)
ZONE 1
(102.38)
BOULDER
ZONE 3
(28.40)
ZONE 2
(27.88)
ZONE 1
(84.17)
Legend:
county boundary
zone boundary
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4520
4500
4480
4460
4440
4420
4400
400
420
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460
480
500
520
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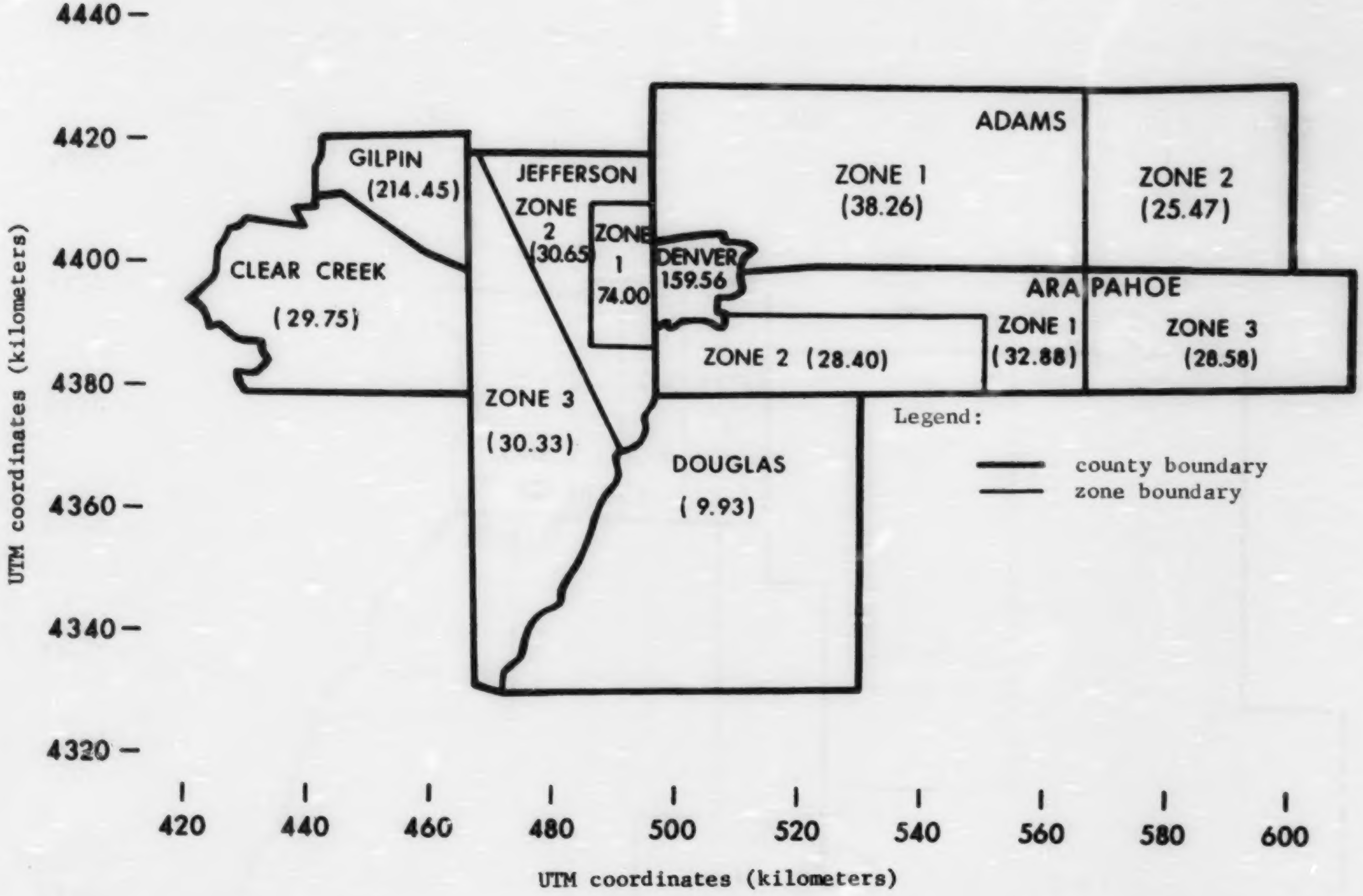
560
580
UTM coordinates (kilometers)
UTM coordinates (kilometers)

Figure 22. Fugitive dust zones for Larimer, Weld, and Boulder Counties (1972 emissions in tons/yr/4 km^2)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UTM coordinates (kilometers)
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440
460
480
500
520
540
560
580
600
UTM coordinates (kilometers)
GILPIN
(214.45)
CLEAR CREEK
(29.75)
JEFFERSON
ZONE
2
(30.65)
ZONE
1
74.00
ZONE 3
(30.33)
DENVER
159.56
ADAMS
ZONE 1
(38.26)
ZONE 2
(25.47)
ARAPAHOE
ZONE 1
(32.88)
ZONE 2 (28.40)
ZONE 3
(28.58)
DOUGLAS
(9.93)
Legend:
county boundary
zone boundary

Figure 23. Fugitive dust zones for Adams, Arapahoe, Clear Creek, Denver, Douglas, Gilpin and Jefferson Counties (1972 emissions in tons/yr/4 km^2)

Table 16. FUGITIVE DUST EMISSION DENSITIES BY ZONES[a] (TONS/YEAR/4 km^2)

County	Zone	Emissions (tons/yr)	Area (sq km)	Emission density (tons/yr/4 km^2)
Adams	1. Cropland	19,360	2025	38.26
	2. Rangeland	6,698	1050	25.47
Arapahoe	1. Cropland	5,680	691	32.88
	2. Rangeland	4,430	624	28.40
	3. Rangeland	5,002	700	28.58
Boulder	1. Cropland	9,848	468	84.17
	2. Rangeland	2,718	390	27.88
	3. Woodland	7,611	1073	28.40
Clear Creek	Predominately woodland	7,437	1000	29.75
Denver	Urban	8,018	201	159.56
Douglas	Rangeland and woodland	5,629	2268	9.93
Gilpin	Predominately woodland	18,228	340	214.45
Jefferson	1. Urban	4,255	230	74.00
	2. Rangeland	5,632	735	30.65
	3. Woodland	7,915	1044	30.33
Larimer	1. Cropland	20,804	1773	46.96
	2. Woodland	12,526	4275	11.72
	3. Recreation land	2,424	822	11.49
Weld	1. Cropland	88,863	3470	102.38
	2. Rangeland	25,749	7681	13.41

[a] Calculation, based upon PEDCo data, is given in Appendix I.

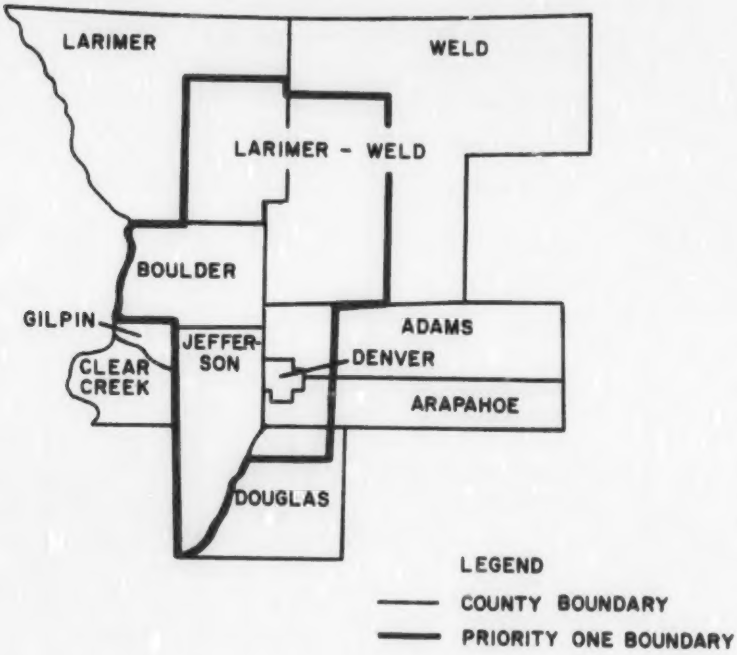
LARIMER
WELD
LARIMER - WELD
BOULDER
GILPIN
CLEAR CREEK
JEFFERSON
ADAMS
DENVER
ARAPAHOE
DOUGLAS
LEGEND
COUNTY BOUNDARY
PRIORITY ONE BOUNDARY

Figure 24. Priority I area in the Denver AQMSA

The actual methodologies for the calculation of emission reductions, due to the above regulation, and for the projection of the fugitive dust emissions to 1985 are detailed in Appendix J. A short discussion of the approach is given below.

Initially, dust emission reductions are calculated for the 1972 emissions inventory (PEDCo study), based on a similar estimate performed by PEDCo of the effect of a draft version of the same regulation. These reductions are determined for emissions from unpaved roads, land development and construction activities, and mining and storage operations.

For unpaved roads, it is necessary to determine what fraction of total travel on unpaved roads would come under the regulation. The procedure assumes that the high volume roads are more likely to be in the Priority I portion of the AQMSA, rather than the less developed areas. The fraction of total daily travel on those unpaved roads with 165 vpd, based on average daily travel on unpaved roads in each county (supplied to PEDCo by the Colorado Division of Highways), is estimated using the method described in the PEDCo study. It is further assumed that all such roads falling under the regulation will be controlled (i.e., no financial constraints) to the control efficiency of 60 percent as stated in the PEDCo study.

Emissions from land development, residential and commercial construction, and highway construction are reduced according to the control efficiencies estimated by PEDCo for the fraction of each county's activity estimated to be in the Priority I area. These control efficiencies are 60 percent for land development and 50 percent for construction activities.

Quarrying, mining, tailings, and aggregate storage are assumed to be controlled throughout the counties to the extent estimated in the PEDCo study (75 percent for mining activities; 25 percent for storage). No controls on cattle feedlots or sand from snow control are assumed.

Total reduced emissions are then re-allocated among the portions of the county previously designated for the allocation of fugitive dust so that a general control factor can be estimated for these zones. These new emission rates then serve as a base line for projecting growth of fugitive source emissions. Given the current timetable for implementation of the regulation, the base line year is assumed to be 1975.

Projections of the emissions of fugitive dust in 1980 and 1985 are estimated by using information on projected travel and social and economic activity and by assuming that several source categories will remain constant: unpaved roads; agriculture; quarrying, mining, and tailings; aggregate storage; and cattle feedlots. It is expected that control measures on an increasing number of unpaved roads would be offset by increased traffic on present low-volume unpaved roads or by new unpaved roads with incomplete control of dust. The other categories are seen as unlikely to greatly change in activity.

Sand on paved roads is expected to increase in direct proportion to total vehicle-miles of travel. The travel data used for this forecast is the travel forecast, by county, supplied by the Colorado Division of Highways.

Land development, residential-commercial construction, and highway construction are assumed to increase in proportion to population, employment, and earnings. In the Denver metropolitan area, forecasts (by the Denver Regional Council of Governments) of land use, by county, by year, have been used to calculate the rate of land conversion and construction. Future activity is then compared to present activity to develop growth factors for emissions. Highway construction activity is estimated directly from DRCOG estimates of land use for roadways. In areas outside the Denver metropolitan areas, land development and construction emissions are also assumed to increase in the same manner as socioeconomic activity. For these areas, the general growth factors for particulates area sources, described earlier in this section, are used to forecast growth in these fugitive dust sources.

Table 17. FUGITIVE DUST EMISSIONS GROWTH RATES BY ZONES[a]

County	Zone	1972-1975	1975-1980	1975-1985
Adams	1. Cropland	0.86	1.04	1.01
	2. Rangeland	0.80	1.07	1.02
Arapahoe	1. Cropland	0.81	0.99	0.97
	2. Rangeland	0.78	0.99	0.96
	3. Rangeland	0.78	0.96	0.96
Boulder	1. Cropland	0.90	1.00	1.00
	2. Rangeland	0.70	1.00	0.99
	3. Woodland	0.70	1.00	0.99
Clear Creek	Predominately woodland	0.86	1.47	1.82
Denver	Urban	0.89	1.12	1.25
Douglas	Rangeland and woodland	0.96	1.50	2.01
Gilpin	Predominately woodland	1.0	1.01	1.02
Jefferson	1. Urban	0.85	1.18	1.30
	2. Rangeland	0.63	1.07	0.95
	3. Woodland	0.63	1.07	0.95
Larimer	1. Cropland	0.95	1.01	1.02
	2. Woodland	0.78	1.05	1.08
	3. Recreation land	0.78	1.05	1.08
Weld	1. Cropland	0.98	1.00	1.00
	2. Rangeland	0.87	1.02	1.03

[a] Based on calculations in Appendix J.

Forecasted fugitive dust is then re-allocated to the zones in the same manner as described earlier and growth rates for these zones are determined. These are presented in Table 17.

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3. Denver Regional Council of Governments. Transportation System Report. December 1973.

4. Kircher, D. S. and D. P. Armstrong. An Interim Report on Motor Vehicle Emission Estimation. Environmental Protection Agency, Office of Air and Water Programs, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina 27711. Publication Number EPA-450/2-73-003, October 1973.

5. U.S. Environmental Protection Agency, Office of Air and Water Programs, Office of Air Quality Planning and Standards. Compilation of Air Pollutant Emission Factors. Table 3.1.5-1 (Second Edition). Research Triangle Park, North Carolina, Publication Number AP-42, April 1973.

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7. Wilbur Smith and Associates. Highway Classification, Needs, and Fiscal Study (1970-1990). Prepared for the Colorado Department of Highways, August 1972.

8. PEDCo - Environmental Specialists, Inc. Investigation of Fugitive Dust - Sources, Emissions, and Control - For Attainment of Secondary Ambient Air Quality Standards, Colorado. Prepared for the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

SECTION IV

ASSESSMENT OF EXISTING AND FUTURE AIR QUALITY

Table 18, published by EPA,[1] includes the national ambient air quality standards for the four pollutants to be addressed in the Denver AQMP, namely, total suspended particulates, carbon monoxide, nitrogen dioxide, and photochemical oxidants. In this section, an assessment of the existing and future air quality is made by comparing measured and projected air quality with these standards.

TOTAL SUSPENDED PARTICULATES

Summary of Observed Concentrations

Annual average and 24-hour average total suspended particulate concentrations were reported in the National Aerometric Data Bank for 34 sampling locations within the Denver Front Range AQMSA during the 3-year period from 1970 to 1972. The annual geometric means at each of these stations are listed in Table 19. Inspection of the data for stations with means for all 3 years shows that the highest mean for the 3-year period occurred in 1970 at seven stations, in 1971 at 17 stations, and in 1972 at six stations. Annual geometric mean data for 1973, made available by the Colorado Department of Health and also listed in Table 19, include values for 28 of the 34 stations. The 1973 annual means at 15 of the 24 stations exceeded the maximum value observed during the previous years. Also, when all stations within the AQMSA having four years of data are averaged, the following annual averages are obtained: 1970 - 83.2 $\mu g/m^3$; 1971 - 86.9 $\mu g/m^3$; 1972 -

Table 18. SUMMARY OF NATIONAL AMBIENT AIR QUALITY STANDARDS[a]

Pollutant	Averaging time	Primary standards	Secondary standards	Comments
Particulate matter	Annual (Geometric mean)	75 $\mu g/m^3$	60 $\mu g/m^3$	The secondary annual standard (60 $\mu g/m^3$) is a guide for assessing SIP's to achieve the 24-hour secondary standard.
	24-hour[b]	260 $\mu g/m^3$	150 $\mu g/m^3$	
Sulfur oxides	Annual (Arithmetic mean)	80 $\mu g/m^3$ (0.03 ppm)	-	
	24-hour[b]	365 $\mu g/m^3$ (0.14 ppm)	-	
	3-hour[b]	-	1300 $\mu g/m^3$ (0.5 ppm)	
Carbon monoxide	8-hour[b]	10 mg/m^3 (9 ppm)	(Same as primary)	
	1-hour[b]	40 mg/m^3 (35 ppm)		
Nitrogen dioxide	Annual (Arithmetic mean)	100 $\mu g/m^3$ (0.05 ppm)	(Same as primary)	The continuous Saltzman, Sodium Arsenite (Christie), TGS, and Chemiluminescence have been proposed as replacements for the J-H method. New FRM to be decided upon by Jan. 1975.
Photochemical oxidants	1-hour[b]	160 $\mu g/m^3$ (0.08 ppm)	(Same as primary)	The FRM measures O_3 (ozone).
Hydrocarbons (nonmethane)	3-hour (6 to 9 a.m.)	160 $\mu g/m^3$ (0.24 ppm)	(Same as primary)	The HC standard is a guide to devising SIP's to achieve the oxidant standard. The HC standard does not have to be met if the oxidant standard is met.

[a] The air quality standards and a description of the reference methods were published on April 30, 1971 in 42 CFR 410, recodified to 40 CFR 50 on November 25, 1972.

[b] Not to be exceeded more than once per year.

Table 19. DENVER FRONT RANGE AQMSA AIR QUALITY DATA; ANNUAL GEOMETRIC MEANS, PARTICULATE MATTER

County	Location	Concentration, $\mu g/m^3$			
		1970[a]	1971[a]	1972[a]	1973[b]
Adams	Westminster	--	70	79	81
	Aurora	73	74	89	94
	Brighton	88	86	87	107
	Adams City	95	89	89	103
Arapahoe	Cherry Creek Dam	42	--	--	45
	Englewood	95	106	102	110
	Littleton	95	113	109	--
Boulder	Boulder	63	65	64	69
	Longmont	92	105	96	129
Clear Creek	Idaho Springs	--	74	66	89
Denver	State Health Dept.	67	69	64	73
	Hull Photo	80	84	74	80
	Julian Street	--	82	84	--
	Sloans Lake	84	--	--	--
	Sewer Plant	135	112	108	133
	Sch. Admin. Bldg. (State)	108	124	127	126
	Gates Building	121	123	125	130
	Sch. Admin. Bldg. (EPA)	122	118	151	--
	2105 Broadway	173	186	152	--
Douglas	Castle Rock	56	65	66	82
Gilpin	Black Hawk	--	52	80	62
Jefferson	Rocky Flats	47	52	38	44
	Golden	60	71	61	70
	Lakewood	60	71	71	75
	Edgewater	88	102	98	86
	Arvada	110	110	107	111
Larimer	La Porte	51	46	50	51
	Fort Collins	88	76	69	71
	Loveland	75	83	82	85
Weld	Greely	75	92	67	95
	Ft. Lufton	85	82	80	91
	Greely	90	99	88	80
	Johnstown	96	100	88	107
	Windsor	100	103	92	--

[a] Data from National Aerometric Data Bank.

[b] Data from Colorado Department of Health.

82.9 $\mu g/m^3$; and 1973 - 91.7 $\mu g/m^3$. Thus it appears that no overall trend in particulate concentrations occurred during the period, although the possibility of increasing concentrations beginning in 1973 can not be ruled out.

Although it is possible that individual sites may be experiencing significant trends, the period of record is too short to validate such changes. A suggested procedure for trend detection outlined in the EPA Guideline Series,[2] for example, recommends the use of a 3-year running average to smooth out year-to-year variations caused by such factors as transient meteorological phenomena and sampling errors. In view of the above, it is assumed that no trend in particulate concentrations occurred during this period within the AQMSA, and that the best estimate of existing concentrations at the various sites can consequently be obtained by averaging the geometric means for the period in question. However, since the individual 24-hour concentrations were not yet available for 1973, and the annual data had not yet appeared in SAROAD, the development of base line data was restricted to the 3 years 1970, 1971, and 1972. The selection of a no-trend option does not differ substantially from the results of the EPA Plan Revision Management System for the Metropolitan Denver Intrastate AQCR[3] which, in summary, states that "Although some progress has been made in controlling TSP, the average air quality change in the past year (year ending with the first quarter of 1973) has been an increase of 3.4 $\mu g/m^3$ with a 24 $\mu g/m^3$ increase at one site."

Table 20 presents the arithmetic average of the annual geometric means observed at each station during this 3-year period (1970-1972). Within each county, sites have been arranged in order of increasing concentration. The percent of 24-hour average concentrations above the primary and secondary standards at the stations are also given for each station. In columns 3, 4, and 5, the location of the monitor is described in terms of surrounding land use, local population and sampling height.

Table 20. AVERAGE CONDITIONS AT SAMPLER LOCATIONS

County	Location	Site description	Population	Sampler height (ft)	No. of years	Mean annual conc (μg/m³)	% Obs. Above 24-hour Standards (primary)	% Obs. Above 24-hour Standards (secondary)	24-hour average (2nd high) (μg/m³)
Adams	Westminster	Sub-Res	19,432	15	2	74	2.5	6.7	281
	Aurora	Sub-Res	74,974	20	3	79	0.4	7.8	207
	Brighton	Cen. City-Comm	7,055	35	3	87	0	6.1	209
	Adams City	Sub-Ind	10,206	15	3	91	0.8	15.0	258
Arapahoe	Cherry Creek Dam	Remote	–	–	1	42	0	1.1	125
	Englewood	Sub-Comm	33,398	20	3	101	1.8	16.4	298
	Littleton	Sub-Comm	13,670	–	3	106	1.6	19.7	345
Boulder	Boulder	Cen. City-Comm	37,718	30	3	64	0	2.6	225
	Longmont	Cen. City-Comm	11,489	30	3	98	5.1	18.8	361
Clear Creek	Idaho Springs	Cen. City-Comm	2,003	18	2	70	0.6	0.6	143
Denver	State Health Dept.	Cen. City-Res.	514,678	60	3	67	0	2.1	178
	Hull Photo	Sub-Comm	514,678	25	3	79	1.3	9.1	263
	Julian Street	Sub-Res	514,678	15	2	83	0.6	7.7	254
	Sloans Lake	Sub-Res	514,678	–	1	84	1.1	7.4	224
	Sewer Plant	Sub-Ind	514,678	10	3	118	4.2	27.9	355
	Sch. Adm. Bldg. (State)	Cen. City-Comm	514,678	50	3	120	8.2	32.3	347
	Gates Bldgs.	Cen. City-Ind	514,678	25	3	123	6.5	32.0	392
	Sch. Adm. Bldg. (EPA)	Cen. City-Comm	514,678	43	3	130	7.8	36.3	332
	2105 Broadway	Cen. City-Comm	514,678	9	3	170	18.0	56.0	729
Douglas	Castle Rock	Cen. City-Comm	1,152	15	3	62	0.8	2.3	314
Gilpin	Blackhawk	Cen. City-Comm	217	40	2	66	0.6	0.6	131
Jefferson	Rocky Flats	Rural	–	10	3	46	0	2.3	154
	Golden	Sub-Ind	7,118	20	3	64	0	3.3	187
	Lakewood	Sub-Res	19,338	15	3	67	0	4.5	189
	Edgewater	Sub-Comm	4,866	35	3	96	1.6	15.2	262
	Arvada	Sub-Comm	46,814	15	3	109	1.8	21.4	239
Larimer	La Porte	Rural-Comm	200	35	3	49	0	1.3	163
	Fort Collins	Cen. City-Comm	43,337	30	3	78	0.4	7.0	236
	Loveland	Cen. City-Comm	9,734	24	3	80	1.6	11.8	291
Weld	Greely	Cen. City-Comm	38,902	25	3	78	2.4	13.0	280
	Ft. Lufton	Cen. City-Comm	2,489	30	3	82	0.4	7.6	260
	Greely	Sub-Ind	38,902	25	3	92	2.7	23.5	299
	Johnstown	Cen. City-Comm	1,191	18	3	95	0.8	19.9	220
	Windsor	Cen. City-Res	1,564	25	3	98	2.0	30.8	280

Table 20 shows that the annual secondary standard of 60 $\mu g/m^3$ (a guide for assessing implementation plans to achieve the 24-hour standard) was exceeded at all sites except the predominately rural or remote sites: Cherry Creek Dam in Arapahoe County, Rocky Flats in Jefferson County, and LaPorte in Larimer County. The primary annual standard of 75 $\mu g/m^3$ was exceeded at 23 of the 34 stations. Highest concentrations were observed in the commercial areas of downtown Denver where the secondary standard was exceeded about one-third of the time. The highest 3-year average concentration of 170 $\mu g/m^3$, observed at the 2105 Broadway site, presumably reflects the low sampling height of 9 feet at this measurement station.[4] Figure 25 illustrates the spatial distribution of annual concentration levels by means of isopleths of concentration equal to 60, 75, 100, and 125 $\mu g/m^3$. The concentrations shown in the figure are the 3-year mean values given in Table 20. It should be recognized that nearly all monitoring locations are in business or residential areas and that the 60 and 75 $\mu g/m^3$ isopleths, therefore, indicate the bounds within which in-town concentrations are likely to have exceeded the standards rather than that all locations within these isopleths did so.

Table 21 has been prepared as an aid in developing effective strategies for the attainment and maintenance of the total suspended particulate ambient standards. It presents by month, for each of the 34 sampling stations, the percentage of the 24-hour observations during the 3-year period that exceeded the secondary standards. Average values for all sites and for Weld County sites only are given at the bottom of the table. The results show that concentrations exceeding the secondary standards occur most frequently during the months from October through April and least frequently during June and July. However, this seasonal trend appears to be much less evident in Weld County, where summertime concentrations also frequently exceed the secondary standards. This may be a reflection of summertime dusty conditions

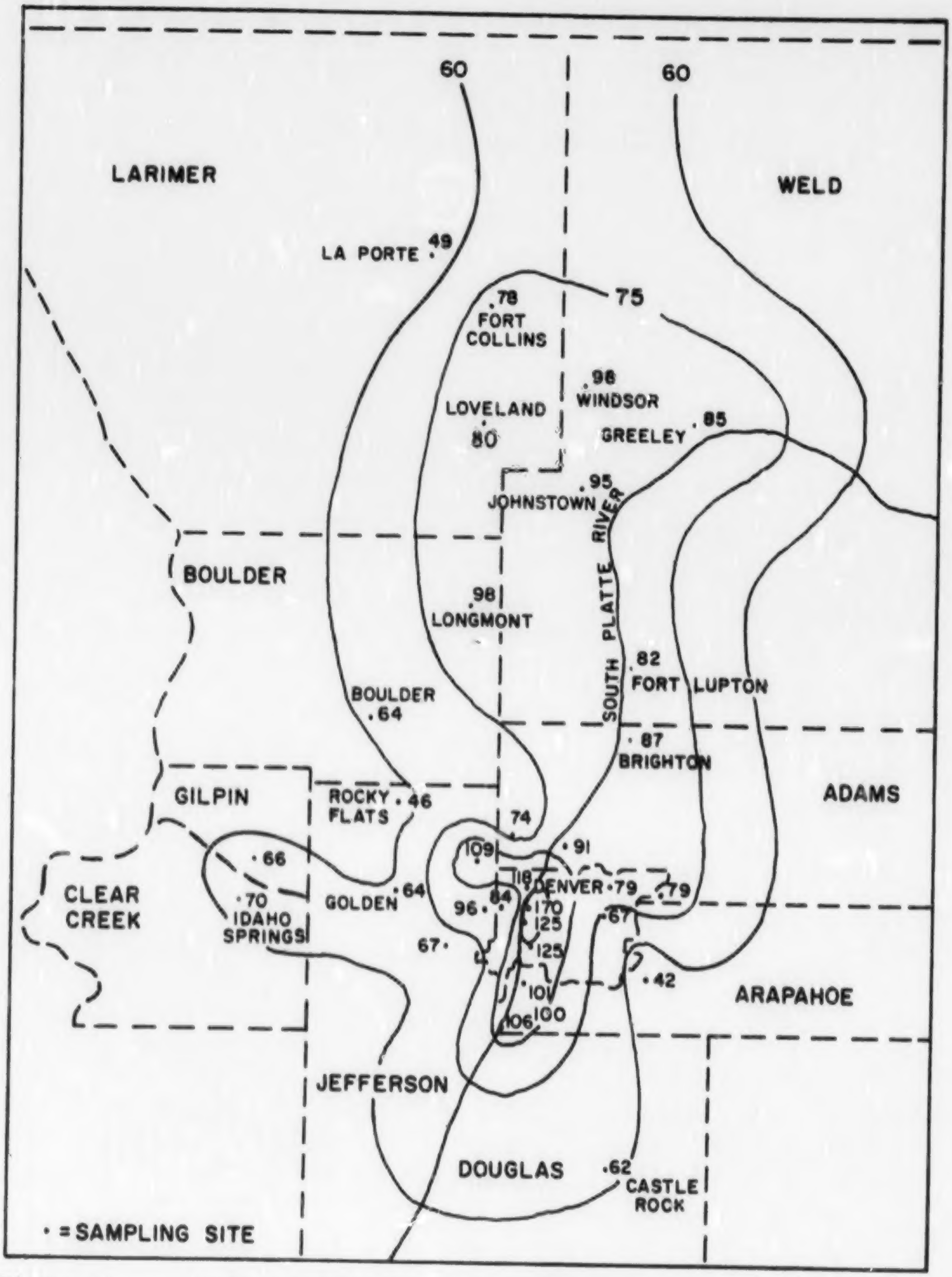
60
60
LARIMER
WELD
LA PORTE .49
.78 FORT COLLINS
75
.96 WINDSOR
LOVELAND . 80
GREELEY . 85
.95 JOHNSTOWN
SOUTH PLATTE RIVER
BOULDER
.98 LONGMONT
.82 FORT LUPTON
BOULDER .64
· 87 BRIGHTON
GILPIN
ROCKY FLATS . 46
ADAMS
74
109
· 91
· 66
118
DENVER ·79
79
CLEAR CREEK
·70 IDAHO SPRINGS
GOLDEN 64
96·
84
170
125
67
67·
125
101
· 42
ARAPAHOE
106
100
JEFFERSON
DOUGLAS
·62 CASTLE ROCK
· = SAMPLING SITE

Figure 25. Average annual suspended particulate concentrations measured within the Denver AQMSA during 1970-1972. Units are µg/m^3.

Table 21. PERCENTAGE OF OBSERVATIONS EXCEEDING THE SECONDARY STANDARDS

County	Location	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Adams	Westminster	0	0	0	14.3	0	0	0	0	25.0	16.7	18.8	21.4
	Aurora	7.7	14.3	4.3	0	12.5	0	0	4.2	4.2	10.5	4.3	35.0
	Brighton	0	9.5	4.5	5.0	0	0	0	0	5.9	11.1	19.0	30.8
	Adams City	14.2	47.6	13.6	8.7	8.0	4.3	0	16.0	4.2	16.7	13.0	44.4
Arapahoe	Cherry Creek Dam	0	0	0	0	0	0	0	0	12.5	0	0	0
	Englewood	23.1	38.1	20.8	21.7	4.0	4.2	0	0	8.7	20.0	21.7	40.0
	Littleton	23.5	42.9	18.8	25.0	0	0	0	12.5	15.4	33.3	35.7	41.7
Boulder	Boulder	0	0	4.3	4.8	3.8	0	0	0	0	7.1	9.1	0
	Longmont	17.4	56.2	8.0	22.2	5.9	0	0	6.7	20.0	37.5	33.3	38.5
Clear Creek	Idaho Springs	0	0	0	0	0	6.2	0	0	0	0	0	0
Denver	State Health Dept.	3.7	4.8	4.0	4.5	0	0	0	0	4.0	0	4.3	0
	Hull Photo	13.0	10.0	0	11.8	5.0	0	0	4.3	10.5	5.9	10.5	38.9
	Julian Street	0	15.4	0	0	0	0	0	0	12.5	15.4	25.0	30.8
	Sloans Lake	33.0	14.3	0	33.3	0	0	0	0	0	0	0	0
	Sewer Plant	20.8	50.0	31.8	33.3	13.0	9.1	18.8	16.0	17.4	41.2	33.3	83.3
	Sch. Admin. Bldg. (State)	26.7	72.7	50.0	7.7	12.5	9.1	0	6.2	15.4	50.0	69.2	81.8
	Gates Bldgs.	54.2	76.5	47.8	27.8	11.1	0	10.0	10.5	10.0	20.0	30.0	82.4
	Sch. Admin. Bldg. (EPA)	62.5	50.0	28.6	28.6	16.7	28.6	0	0	0	33.3	83.3	85.7
	2105 Broadway	86.7	86.8	77.5	48.7	34.3	26.9	18.9	28.6	35.1	64.1	83.3	83.3
Douglas	Castle Rock	0	0	0	0	0	0	0	0	7.1	5.0	9.1	10.5
Gilpin	Black Hawk	7.7	0	0	0	0	0	0	0	0	0	0	0
Jefferson	Rocky Flats	3.8	4.8	4.2	0	0	0	4.5	0	0	5.3	0	5.3
	Golden	3.8	0	0	4.3	0	0	0	0	8.7	10.5	8.3	5.6
	Lakewood	9.1	0	0	0	0	0	0	0	4.2	5.6	17.4	21.1
	Edgewater	20.8	30.0	22.7	13.6	4.0	4.0	4.5	0	12.5	16.7	21.7	36.8
	Arvada	26.9	42.9	34.8	34.8	16.7	4.0	0	0	13.0	21.1	25.0	44.4
Larimer	La Porte	0	0	0	0	5.0	0	0	0	0	5.0	4.5	0
	Fort Collins	4.8	13.0	4.2	20.8	9.1	0	0	0	0	10.0	12.5	5.6
	Loveland	16.7	14.3	20.8	8.7	8.7	11.5	15.8	3.8	0	6.2	14.3	25.0
Weld	Greely	14.8	20.0	25.0	12.5	8.0	19.0	9.5	8.0	5.6	9.1	4.8	23.8
	Ft. Lufton	16.0	13.6	12.5	4.8	4.5	0	4.8	4.2	11.8	0	6.2	7.7
	Greely	7.7	13.6	22.7	21.7	20.8	15.0	17.4	34.6	25.0	45.5	16.7	35.0
	Johnstown	13.0	35.0	29.2	30.4	8.3	12.5	9.1	12.0	11.8	36.4	17.4	26.3
	Windsor	6.2	36.4	38.1	20.8	20.0	41.7	29.[illegible]	42.3	40.0	38.1	35.3	8.3
All Stations		16.3	25.5	17.6	14.8	7.6	5.8	5.[illegible]	7.5	10.6	19.5	20.2	30.7
Weld County Only		12.5	23.6	25.2	18.7	12.5	18.3	14.4	20.6	18.1	28.0	15.8	22.4

resulting from fugitive sources, as was found to be the case in two cities in Idaho.[5]

Figure 26, prepared from Table 20, shows the relationship between the annual geometric mean and the percentage of the 24-hour average concentrations that were above the secondary standard. The Weld County data, which show a greater percentage of observations above the standard than the observations from the remaining counties for a given annual mean, have been treated separately in the figure.

To estimate the percentage of reduction in man-made emissions required to achieve and maintain air quality, annual averages are used, and a background level of 30 $\mu g/m^3$ is assumed in agreement with the State Implementation Plan calculations.[6] The emission reductions required, using proportional rollback, are given by the equation

$$R = \frac{A - C}{A - B} \times 100$$

where A = annual geometric mean
B = background concentration
C = national ambient standard

Before selecting the annual geometric mean to be used to calculate the required reduction in emissions affecting downtown Denver, the data in Tables 19 and 20 were considered in detail. If one accepts in principle the assumption that the best available estimate of existing air quality at each site is obtained by averaging the annual means for the 3 years, and if one further eliminates from consideration data obtained at heights below 15 feet in line with the philosophy given in the draft Guideline Series document OAQPS No. 1.2-012,[4] the use of an annual mean of 130 $\mu g/m^3$ is indicated for the rollback calculations. On the other hand,

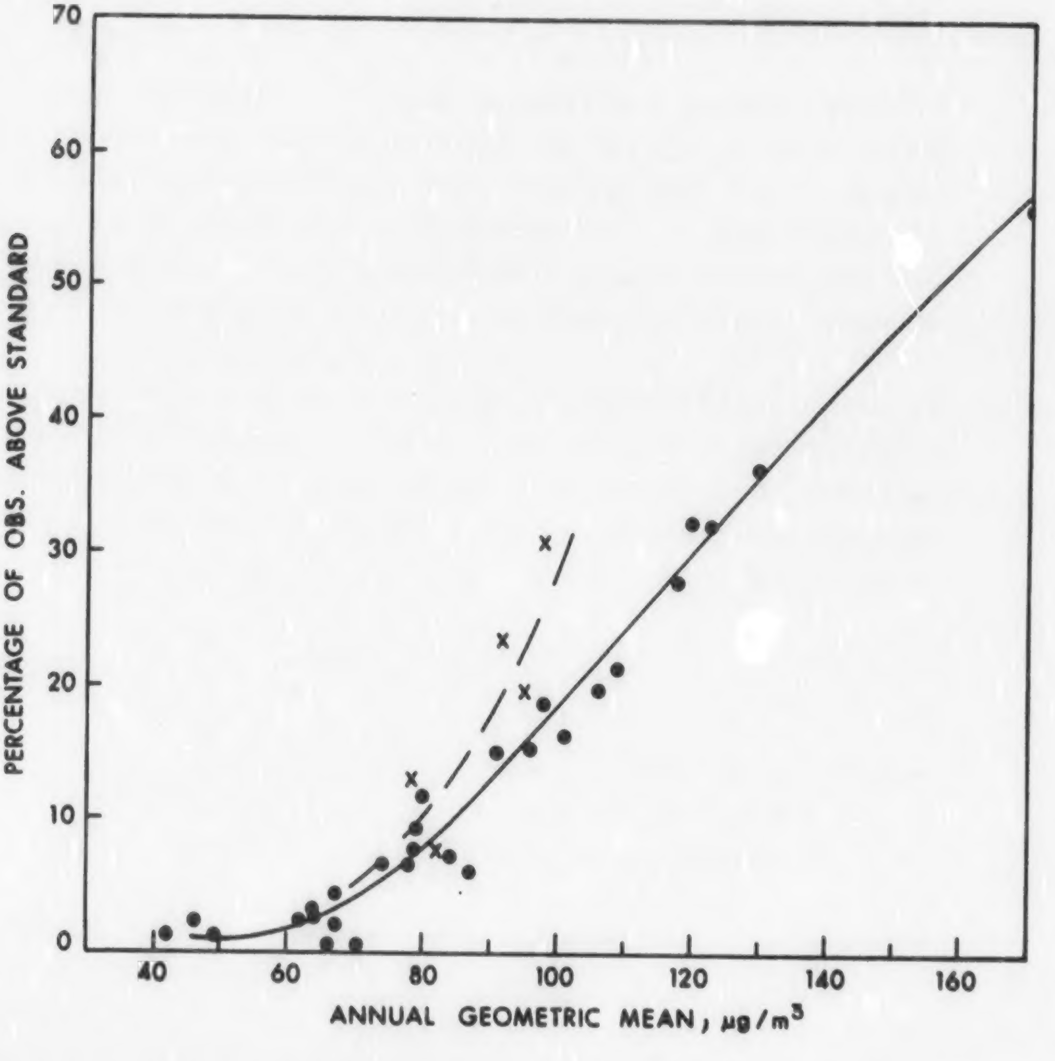

Figure 26 Relationship between the annual geometric mean of total suspended particulate concentration and the percentage of 24-hour average concentrations above the secondary standard. Weld County data are indicated by X's; data from all other sites are indicated by ●'s.

this mean was obtained from 77 observations made at the School Administration Building, whereas 248 observations during the same period by a different agency at this building gave a mean of 120 $\mu g/m^3$ for the same 3-year period. A second approach is to examine the means for the 3 separate years, again omitting observations made below 15 feet. The highest annual geometric mean of 151 $\mu g/m^3$ was calculated from 26 observations at the School Administration Building in 1972, while the annual mean from the other set of measurements at this site in 1972, consisting of 79 observations, was 127 $\mu g/m^3$. Thus, justification exists for the selection of a baseline concentration from below 130 $\mu g/m^3$ to the use of one as high as 151 $\mu g/m^3$. For the development of the AQMP, a value of 130 $\mu g/m^3$ will be used. The use of the proportional rollback equation with this value gives the reduction that would be required to meet the primary standard in Denver County as

$$R = \frac{130 - 75}{130 - 30} \times 100 = 55 \text{ percent}$$

and the reduction required to meet the secondary standard as

$$R = \frac{130 - 60}{130 - 30} \times 100 = 70 \text{ percent}$$

It must be recognized, however, that the use of 151 $\mu g/m^3$ as the baseline value would result in required reductions of 63 and 75 percent to meet the primary and secondary standards, respectively.

It also is apparent that emissions affecting many of the smaller cities in the AQMSA will have to be reduced substantially before the standards can be achieved and maintained. As an indication of the maximum reduction required, the 3-year average of the annual geometric means in both Longmont and Windsor is 98 $\mu g/m^3$ (see Table 20 or Figure 27).

This leads to the following required reductions:

To meet the primary standard

$$R = \frac{98 - 75}{98 - 30} \times 100 = 34 \text{ percent}$$

and, to meet the secondary standard

$$R = \frac{98 - 60}{98 - 30} \times 100 = 56 \text{ percent}$$

Reductions required in other cities in the AQMSA can be similarly estimated from the data presented in Table 20.

Modeling of Particulate Air Quality

Atmospheric modeling is used to help provide projections of particulate air quality. First, the technique helps to analyze the spatial concentration pattern of a pollutant and secondly, it describes changes in this pattern due to variations in source strengths during the period of interest. The models are also calibrated with actual air quality measurements so that the air quality may be projected over a much larger area than that covered by the network of stations.

There are several ingredients which must be present as input to a meaningful air quality modeling analysis. Due to the general proportionality between concentration and source strength, the most important requisite is a rather detailed knowledge of the magnitude and spatial distribution of the emissions. Area source boundaries should be arranged so that the variation of emissions across a given grid square is kept to a minimum. Point sources should be characterized according to height, flow rate, and stack gas temperature. The meteorological parameters that control the spread of a pollutant after emission include wind speed, wind direction, atmospheric stability, and mixing height.

For this study, the point source locations, emissions, and characteristics were obtained from the National Emissions Data System (NEDS)[7] for the 10 counties in the AQMSA. This data is available upon request from Monitoring and Data Analysis Division, Office of Air Quality Planning and Standards, (OAQPS), Research Triangle Park, North Carolina. The area source emissions were taken from EPA computer-generated maps from OAQPS that give the emissions in hundreds of tons per year for grid squares 2 km on a side. These area source particulate emissions were originally in the form of county totals which were then allocated according to population density by a version of the Computer Assisted Area Source Emissions (CAASE)[8] allocation procedure. Fugitive source emissions were taken from the PEDCo Report[9] and allocated as to land use category. The annual frequency of wind speed, direction, and stability occurrences were obtained for the Denver area from the National Climatic Center in Asheville, North Carolina.

For purposes of air quality projection, it was decided to apply the Climatological Dispersion Model (CDM)[10] to calculate average annual ground level air pollutant concentrations due to point sources. Area source contributions were evaluated by means of the Hanna-Gifford Area Source Model.[11,12] These two different approaches were utilized since the CDM predictions of concentrations due to area source emissions seemed unrealistically low and required excessive amounts of computer time. The CDM was chosen, however, for point sources with buoyant plumes since it can account in more detail for the distribution of wind speeds and stabilities in addition to the presence of a mixing layer.

The Hanna-Gifford model has the advantage that the air quality within a particular grid square may be related directly to the emission density within that square and those immediately adjacent. The concentration within a cell may be calculated according to the following expression which results from an integration of the receptor-oriented Gaussian plume (with lateral diffusion neglected) over upwind area sources.

$$\chi = \frac{\sqrt{\frac{2}{\pi}}\, f_k \left(\frac{\Delta x}{2}\right)^{1-b}}{a(1 - b)\, u} \left[Q_o + \sum_{i=1}^{N} Q_i \left((2_i + 1)^{1-b} - (2_i - 1)^{1-b} \right) \right] \quad (1)$$

where:

χ = ground level air concentration ($\mu g/m^3$)

u = average wind speed (m/sec)

Q_i = source strength for cell i ($\mu g/m^2/sec$)

Δx = cell width (m)

a,b = power law parameters for ($\sigma_z = a\, x^b$), where σ_3 is the plume dispersion in meters

f_k = frequency of wind speed from direction k (k = 1 to 16)

An example calculation and results illustrating the application of this model are presented in Figure 27. For this computation the wind direction frequency distribution (Figure 28) for Denver was used along with an average wind speed of 4.15 m/sec. The emission rate of 0.72 $\mu g/m^2/sec$ corresponds to a source strength of 100 tons/yr/4 km^2 which is rather common for the Denver area. The coefficients a and b were chosen as 0.15 and 0.75, respectively, to approximate Pasquill's slightly stable (D) condition which, according to Gifford[11] is most appropriate to average urban conditions. The resultant concentrations from this sample calculation indicate that the contribution from neighboring squares is likely to be rather negligible compared with the emissions from the square under consideration. By treating only this central square and summing over f_k the resulting expression becomes

$$\chi = \frac{\sqrt{\frac{2}{\pi}} \left(\frac{\Delta x}{2}\right)^{1-b} Q_o}{a(1 - b)\, u} \quad (2)$$

The requirement of a grid spacing of 2 km and a neutral stability condition yields the following simple result.

$$\chi = 120 \frac{Q_o}{u} \quad (3)$$

0	0	0
0	0.72	0
0	0	0

← 2 km →

(a)

0.3	1.3	1.0
1.0	20.8	0.7
0.5	1.4	0.4

(b)

Figure 27. (a) Source strengths in $\mu g/m^2/sec$
(b) Resultant concentrations in $\mu g/m^3$

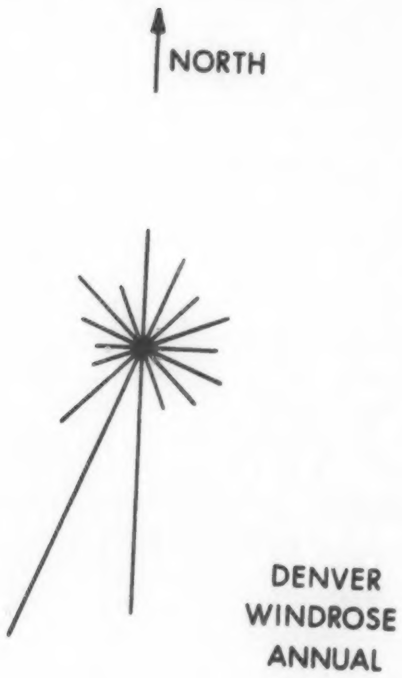

Figure 28. Frequency of wind directions after summation over wind speeds and stabilities

One inch equals ten percent.

Since the particulate area source emissions were allocated by population over a system of 2-km grids, the concentration at a given receptor is found by applying equation (3) to the area source strength for the cell in which the receptor is located. While this procedure is straightforward, its accuracy is somewhat limited because the receptor might not be located near the center of a square. In several cases during the modeling study it was appropriate to interpolate between emission strengths of adjacent squares. There is also the difficulty that the allocation-gridding procedure required (due to format restrictions) that the area source emissions for a 4 km^2 cell are rounded off to the nearest 100 tons/yr, thereby reducing the spatial resolution. Since the fugitive source emissions represented areas of varying size, equation (2) was employed to calculate their contribution to a receptor. For this case the approximation is made that Δx is equal to the square root of the fugitive source emission zone area. A more detailed description of the CDM and Hanna-Gifford model is given in Appendix K.

By use of these techniques average annual ground level air concentrations of particulates were calculated for the air sampling stations mentioned earlier. The results of this calculation, broken down into point, area, and fugitive dust source contributions, are given in Table 22 No background contribution has been added to the source contributions. Table 23 gives the total calculated, measured, and fitted concentrations plus background for the same 34 sampler locations. The correlation coefficient between the calculated concentrations and measured values shown in Table 23 is 0.61. This rather low value for the correlation coefficient is probably due to several factors. The air quality models employed in the study depend upon meteorological parameters which are measured at one location and may not be representative of the entire area of interest. Also, there is currently no simple way of accounting for the effects of topography in pollutant dispersal. The area source emission rates used for the Denver AQMSA were only

Table 22. CALCULATED PARTICULATE CONCENTRATIONS ($\mu g/m^3$)[a]

County	Location and UTM coordinates (km)	Point	Area	Fugitive	Total
Adams	Westminster (496.5,4408.2)	9	21	17	47
	Aurora (511.0,4398.9)	3	0	17	20
	Brighton (515.5,4426.2)	7	0	17	24
	Adams City (505.5,4408.4)	17	10	17	44
Arapahoe	Cherry Creek Dam (515.9, 4388.5)	2	0	11	13
	Englewood (501.0,4386.3)	8	21	11	40
	Littleton (498.4,4384.6)	13	10	11	34
Boulder	Boulder (476.3,4429.6)	1	42	10	53
	Longmont (491.4,4445.9)	2	21	32	55
Clear Creek	Idaho Springs (456.3, 4399.0)	1	0	12	13
Denver	State Health Dept.(506.6, 4397.8)	5	21	54	80
	Hull Photo (506.2,4402.1)	6	31	54	91
	Julian Street (497.3, 4399.7)	12	42	54	108
	Sloans Lake (495.9,4400.0)	22	31	54	107
	Sewer Plant (502.3,4404.1)	14	10	54	78
	Sch. Admin. Bldg. (500.6, 4398.8)	22	42	54	118
	Gates Building (501.1, 4394.0)	22	31	54	107
	Sch. Admin. Bldg. (500.6, 4398.8)	22	42	54	118
	2105 Broadway (501.1,4399.9)	18	31	54	103
Douglas	Castle Rock (512.1,4357.9)	1	0	5	6
Gilpin	Black Hawk (457.5,4405.6)	1	0	78	79
Jefferson	Rocky Flats (483.6,4415.4)	4	0	12	16
	Golden (480.8,4400.5)	5	0	12	17
	Lakewood (490.7,4395.5)	9	0	26	35
	Edgewater (494.8,4400.1)	56	21	26	103
	Arvada (493.0,4405.2)	6	10	26	42
Larimer	La Porte (487.8,4497.1)	2	0	6	8
	Fort Collins (493.3,4492.5)	3	21	21	45
	Loveland (494.0,4471.8)	3	21	21	45
Weld	Greely (526.0,4474.9)	13	10	50	73
	Ft. Lufton (516.1,4436.7)	4	0	50	54
	Greely (527.4,4474.4)	9	10	50	69
	Johnstown (507.6,4464.8)	2	0	50	52
	Windsor (508.1,4480.9)	3	0	50	53

[a] Based on NEDS and PEDCo emissions inventory.

Table 23. FITTED PARTICULATE CONCENTRATIONS ($\mu g/m^3$)

County	Location	Calculated	Measured	Fitted plus background
Adams	Westminster	47	74	70
	Aurora	20	79	47
	Brighton	24	87	51
	Adams City	44	91	68
Arapahoe	Cherry Creek Dam	13	42	41
	Englewood	40	101	64
	Littleton	34	106	59
Boulder	Boulder	53	64	75
	Longmont	55	98	77
Clear Creek	Idaho Springs	13	70	41
Denver	State Health Dept.	80	67	98
	Hull Photo	91	79	108
	Julian Street	108	83	122
	Sloans Lake	107	84	122
	Sewer Plant	78	118	97
	Sch. Admin. Bldg. (State)	118	120	131
	Gates Building	107	123	122
	Sch. Admin. Bldg. (EPA)	118	120	131
	2105 Broadway	103	170	118
Douglas	Castle Rock	6	62	35
Gilpin	Black Hawk	79	66	98
Jefferson	Rocky Flats	16	46	44
	Golden	17	64	45
	Lakewood	35	67	60
	Edgewater	103	96	118
	Arvada	42	109	66
Larimer	La Porte	8	49	37
	Fort Collins	45	78	69
	Loveland	45	80	69
Weld	Greely	73	78	92
	Ft. Lufton	54	82	76
	Greely	69	92	89
	Johnstown	52	95	75
	Windsor	53	98	75

approximate due to the roundoff problem for the gridding procedure mentioned earlier and the fact that the fugitive dust allocation technique lacked necessary resolution.

The fitted concentration values, which are used in the subsequent air quality projections and strategies, were calculated by means of a one parameter linear least squares fit to the measured concentration after subtraction of a background of 30 $\mu g/m^3$ recommended in the Colorado State Implementation Plan. The following relationship then holds between the calculated concentration χ_c, the fitted concentration χ_f, and the fitted concentration plus background χ_{fb}:

$$\chi_f = 0.856\ \chi_c \tag{4}$$

$$\chi_{fb} = \chi_f + 30 \tag{5}$$

Fitted values for air quality were used to smooth out the irregularities in the measured air quality data which might be due to localized nearby sources particularly for those air samplers located close to the ground. An alternate procedure would be to choose the fitted value to be the measured value minus the 30 $\mu g/m^3$ background for those stations whose measurements were not highly influenced by sources in the immediate vicinity of the sampler. Since this approach would have required a detailed analysis of each sampler location which was beyond the scope of this effort, the former procedure was chosen.

Projected Concentrations

The modeling described above, coupled with the growth rates presented in the previous section, allows for projections of the total air quality to 1975, 1980, and 1985 while maintaining an understanding of the contribution from the different types of sources of particulate matter: fugitive dust, point sources, area sources. The percentage contribution of each of these sources to the increase in concentration (Adj.

AQ minus the background contribution of 30 $\mu g/m^3$) is given in Table 24 for 1972. The current air quality is basically assumed to change directly with the changes projected by the emission growth rates. Under the model used for area and point sources, this provides the exact changes; however, for the point sources, some inaccuracy occurs.

While the projected growth rates (base year 1975) for particulates are quite small, meaning any inaccuracy due the above assumptions is minimal, the reduction between 1972 and 1975 as a result of emission regulations is appreciable, allowing much more chance for error. To preclude this occurrence, the CDM model was run for the projected 1975 emissions inventory, which was derived by applying the State regulations to all point sources over 100 tons/year (see Appendix G). This provides a new projected set of concentrations, adjusted to 1975. The change in concentration between before and after the regulations are applied is calculated (Table 25) and used as the growth rate for point sources between 1972 and 1975.

Applying the various growth rates to the contributions from each source sector and adjusting for the background levels, percentage contributions and projected total fitted plus background concentrations for 1975, 1980 and 1985 are calculated. These values are given in Tables 26, 27, and 28. The projected total fitted plus background concentrations for the years 1972, 1975, 1980 and 1985 are again presented in Table 29.

In spite of the SIP attainment strategies, the concentration of suspended particulates for 1975 will still be above the primary (75 $\mu g/m^3$) and secondary (60 $\mu g/m^3$) air quality standards at several stations, especially in Denver County. The measurement locations in Adams, Arapahoe, Boulder, Clear Creek, Douglas, Jefferson, and Larimer Counties are projected to be at or below the primary standard. Gilpin County should really be included in this list since the 1972 average

Table 24. PERCENTAGE CONTRIBUTION OF PARTICULATE SOURCE SECTORS
1972

		% Contribution			
County	Location	Point[a]	Area	Fug.	Adj. AQ[b]
Adams	Westminster	19	45	36	70
	Aurora	15	--	85	47
	Brighton	29	--	71	51
	Adams City	39	22	39	68
Arapahoe	Cherry Creek Dam	15	--	85	41
	Englewood	20	53	27	64
	Littleton	38	30	32	59
Boulder	Boulder	2	79	19	75
	Longmont	4	38	58	77
Clear Creek	Idaho Springs	8	--	92	41
Denver	State Health Dept.	6	26	68	98
	Hull Photo	7	34	59	108
	Julian Street	10	40	50	122
	Sloans Lake	21	29	50	122
	Sewer Plant	18	13	69	97
	Sch. Admin. Bldg. (State)	19	35	46	131
	Gates Building	21	29	50	122
	Sch. Admin. Bldg. (EPA)	19	35	46	131
	2105 Broadway	17	30	53	118
Douglas	Castle Rock	17	--	83	35
Gilpin	Black Hawk	1	--	99	98
Jefferson	Rocky Flats	25	--	75	44
	Golden	29	--	71	45
	Lakewood	26	--	74	60
	Edgewater	54	20	25	118
	Arvada	14	24	62	66
Larimer	La Porte	25	--	75	37
	Fort Collins	6	47	47	69
	Loveland	6	47	47	69
Weld	Greely	18	14	68	89
	Ft. Lufton	7	--	93	76
	Greely	13	14	73	89
	Johnstown	4	--	96	75
	Windsor	6	--	94	75

[a] Based on 1972 NEDS.

[b] Adj. AQ is the fitted air quality adjusted for background contributions in $\mu g/m^3$.

Table 25. CALCULATED PARTICULATE CONCENTRATIONS DUE TO POINT SOURCES[a] - 1972 AND 1975[b] ($\mu g/m^3$)

County	Location	Concentration		% Reduction
		1972	1975[b]	
Adams	Westminster	9	1	89
	Aurora	3	1	67
	Brighton	7	3	57
	Adams City	17	8	53
Arapahoe	Cherry Creek Dam	2	0	100
	Englewood	8	1	88
	Littleton	13	3	77
Boulder	Boulder	1	0	100
	Longmont	2	1	50
Clear Creek	Idaho Springs	1	0	100
Denver	State Health Dept.	5	1	80
	Hull Photo	6	2	67
	Julian Street	12	2	83
	Sloans Lake	22	3	86
	Sewer Plant	14	6	57
	Sch. Admin. Bldg. (State)	22	4	82
	Gates Building	22	3	86
	Sch. Admin. Bldg. (EPA)	22	4	82
	2105 Broadway	18	5	72
Douglas	Castle Rock	1	0	100
Gilpin	Black Hawk	1	0	100
Jefferson	Rocky Flats	4	2	50
	Golden	5	2	60
	Lakewood	9	1	89
	Edgewater	56	4	93
	Arvada	6	1	83
Larimer	La Porte	2	0	100
	Fort Collins	3	1	67
	Loveland	3	1	67
Weld	Greely	13	2	85
	Ft. Lufton	4	1	75
	Greely	9	1	89
	Johnstown	2	0	100
	Windsor	3	0	100

[a] Calculated with the Climatological Dispersion Model.

[b] 1972 NEDS data with Colorado regulations applied to all point sources over 100 tons/year.

Table 26. PERCENTAGE CONTRIBUTION OF PARTICULATE SOURCE SECTORS[a]
1975

County	Location	% Contribution			Adj. AQ[b]
		Point	Area	Fug.	
Adams	Westminster	3	60	37	63
	Aurora	6	--	94	43
	Brighton	12	--	88	45
	Adams City	19	35	46	57
Arapahoe	Cherry Creek Dam	--	--	100	37
	Englewood	3	71	26	58
	Littleton	9	52	39	48
Boulder	Boulder	--	87	13	75
	Longmont	2	44	54	75
Clear Creek	Idaho Springs	--	--	100	39
Denver	State Health Dept.	1	32	67	92
	Hull Photo	2	40	58	101
	Julian Street	2	47	51	110
	Sloans Lake	3	39	58	101
	Sewer Plant	8	17	75	85
	Sch. Admin. Bldg. (State)	4	47	49	114
	Gates Building	3	40	57	102
	Sch. Admin. Bldg. (EPA)	4	47	49	114
	2105 Broadway	5	39	56	103
Douglas	Castle Rock	--	--	100	34
Gilpin	Black Hawk	--	--	100	97
Jefferson	Rocky Flats	12	--	88	37
	Golden	11	--	89	38
	Lakewood	4	--	96	50
	Edgewater	4	48	48	69
	Arvada	3	33	64	59
Larimer	La Porte	--	--	100	34
	Fort Collins	2	54	44	70
	Loveland	2	54	44	70
Weld	Greely	3	19	78	83
	Ft. Lufton	2	--	98	73
	Greely	2	18	80	82
	Johnstown	2	--	98	73
	Windsor	2	--	98	72

[a] Based on application of current regulations.

[b] Adj. AQ is the fitted air quality adjusted for background contributions in $\mu g/m^3$.

Table 27. PERCENTAGE CONTRIBUTION OF PARTICULATE SOURCE SECTORS[a] 1980

County	Location	% Contribution			
		Point	Area	Fug.	Adj. AQ
Adams	Westminster	3	62	35	67
	Aurora	7	--	93	44
	Brighton	15	--	85	46
	Adams City	19	36	45	59
Arapahoe	Cherry Creek Dam	--	--	100	37
	Englewood	3	73	24	60
	Littleton	10	54	36	49
Boulder	Boulder	--	88	12	78
	Longmont	2	47	51	78
Clear Creek	Idaho Springs	--	--	100	43
Denver	State Health Dept.	1	32	67	99
	Hull Photo	2	39	59	109
	Julian Street	2	45	53	117
	Sloans Lake	3	38	59	108
	Sewer Plant	7	16	77	90
	Sch. Admin. Bldg. (State)	4	46	50	123
	Gates Building	3	39	58	110
	Sch. Admin. Bldg. (EPA)	4	46	77	123
	2105 Broadway	4	38	58	111
Douglas	Castle Rock	--	--	100	36
Gilpin	Black Hawk	--	--	100	98
Jefferson	Rocky Flats	13	--	87	38
	Golden	11	--	89	39
	Lakewood	5	--	95	53
	Edgewater	4	45	51	73
	Arvada	3	32	65	64
Larimer	La Porte	--	--	100	34
	Fort Collins	2	60	38	76
	Loveland	2	60	38	76
Weld	Greely	4	22	74	85
	Ft. Lufton	18	--	82	81
	Greely	2	21	77	85
	Johnstown	2	--	98	73
	Windsor	2	--	98	72

[a] Based on application of current regulations.

[b] Adj. AQ is the fitted air quality adjusted for background contributions in $\mu g/m^3$.

Table 28. PERCENTAGE CONTRIBUTION OF PARTICULATE SOURCE SECTORS[a] 1985

County	Location	% Contribution			Adj. AQ[b]
		Point	Area	Fug.	
Adams	Westminster	3	65	32	68
	Aurora	9	--	91	44
	Brighton	17	--	83	46
	Adams City	21	37	42	86
Arapahoe	Cherry Creek Dam	--	--	100	37
	Englewood	4	76	20	63
	Littleton	12	55	33	51
Boulder	Boulder	--	88	12	83
	Longmont	2	50	48	80
Clear Creek	Idaho Springs	--	--	100	46
Denver	State Health Dept.	1	32	67	107
	Hull Photo	2	39	59	117
	Julian Street	2	45	53	125
	Sloans Lake	3	37	60	115
	Sewer Plant	7	16	77	97
	Sch. Admin. Bldg. (State)	4	46	50	132
	Gates Building	3	39	58	118
	Sch. Admin. Bldg. (EPA)	4	46	50	132
	2105 Broadway	4	38	58	119
Douglas	Castle Rock	--	--	100	38
Gilpin	Black Hawk	--	--	100	99
Jefferson	Rocky Flats	17	--	83	38
	Golden	16	--	84	38
	Lakewood	5	--	95	56
	Edgewater	3	45	52	77
	Arvada	3	33	64	68
Larimer	La Porte	--	--	100	34
	Fort Collins	3	64	33	83
	Loveland	3	64	33	83
Weld	Greely	5	25	70	89
	Ft. Lufton	3	--	97	73
	Greely	2	24	74	88
	Johnstown	3	--	97	74
	Windsor	4	--	96	73

[a] Adj. AQ is the fitted air quality adjusted for background contributions in $\mu g/m^3$.

[b] Based on application of current regulations.

Table 29. FITTED PARTICULATE AIR QUALITY FOR 1972,1975,1980,1985[a,b]

County	Location	1972	1975	1980	1985
Adams	Westminster	70	63	67	68
	Aurora	47	43	44	44
	Brighton	51	45	46	46
	Adams City	68	57	59	86
Arapahoe	Cherry Creek Dam	41	37	37	37
	Englewood	64	58	60	63
	Littleton	59	48	49	51
Boulder	Boulder	75	75	78	83
	Longmont	77	75	78	80
Clear Creek	Idaho Springs	41	39	43	46
Denver	State Health Dept.	98	92	99	107
	Hull Photo	108	101	109	117
	Julian Street	122	110	117	125
	Sloans Lake	122	101	108	115
	Sewer Plant	97	85	90	97
	Sch. Admin. Bldg. (State)	131	114	123	132
	Gates Building	122	102	110	118
	Sch. Admin. Bldg. (EPA)	131	114	123	132
	2105 Broadway	118	103	111	119
Douglas	Castle Rock	35	34	36	38
Gilpin	Black Hawk	98	97	98	99
Jefferson	Rocky Flats	44	37	38	38
	Golden	45	38	39	38
	Lakewood	60	50	53	56
	Edgewater	118	69	73	77
	Arvada	66	59	64	68
Larimer	La Porte	37	34	34	34
	Fort Collins	69	70	76	83
	Loveland	69	70	76	83
Weld	Greely	89	83	85	89
	Ft. Lufton	76	73	81	73
	Greely	89	82	85	88
	Johnstown	75	73	73	74
	Windsor	75	72	72	73

[a] Adjusted AQ is the fitted air quality adjusted for background contributions in $\mu g/m^3$.

[b] 1975-1985 based on application of current regulations.

measured concentrations of 66 $\mu g/m^3$ indicates that the estimate of fugitive dust source strength was in error. The values for Weld County are only slightly above the primary standard. This indicates that the current regulations are not sufficient for the attainment of secondary standards throughout the AQMSA or for the primary standards in Denver County. Therefore, more strict controls are assumed to be necessary to provide the attainment of standards.

To estimate the additional percentage of reduction in man-made emissions necessary to attain the particulate air quality standards after consideration of the current regulations, the proportional rollback technique can be used on the 1975 data in Table 26. Thus, the additional reduction necessary to achieve the primary standard in downtown Denver would be

$$R = \frac{114-75}{114-30} \times 100 = 46 \text{ percent}$$

and for the secondary standard it is

$$R = \frac{114-60}{114-30} \times 100 = 64 \text{ percent}$$

In the more rural regions, the attainment of the secondary standards requires a further reduction of

$$R = \frac{83-60}{83-30} \times 100 = 43 \text{ percent}$$

Such contingency planning, which is essential prior to the final development of maintenance planning, is addressed in Section V of this report.

A review of Table 29 indicates that there is an upward trend in projected particulate concentrations over the 10-year period (1975-1985).

Increases range from 0 to 54 percent with most increases less than 20 percent. These increases are what the maintenance planning should be geared to. The 10-year projection of air quality shows that, with the possible exception of Arapahoe, Douglas, Gilpin, and Jefferson Counties, all or parts of the remaining counties would also exceed the primary standard for suspended particulates if no further attainment or maintenance controls are implemented. Section VI of this report discusses what maintenance strategies might be used.

It should be noted that this growth of particulate concentrations is not in agreement with the projected air quality provided in the EPA Plan Revision Management System (PRMS) for the Metropolitan Denver Intrastate AQCR.[3] The PRMS projects a decreasing concentration of particulates with a leveling off between 1975 and 1978. It is felt that the projections provided in this report are more representative of the expected situation due to the inclusion and detailed analysis of fugitive dust contributions.

CARBON MONOXIDE

Summary of Observed Concentrations

Nearly continuous measurements of carbon monoxide by nondispersive infrared instrumentation are available from the CAMP station in the Denver Central Business District (CBD) from January 1971 through July 1973 with the exception of the period from June through September in 1971. Observations were made by five additional state-operated monitors located within the Denver area during much of 1973. The highest and second highest one-hour and eight-hour concentrations at these sites, and the periods covered, are given in Table 30. The eight-hour concentrations reported in this table are based on three discrete eight-hour periods per day beginning at midnight as recommended in a draft report 13 from the EPA Guideline Series.* When these results are compared with the national

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*A recent revision to the referenced guideline recommends the use of the 8-hour running mean in place of the three discrete periods.

Table 30. DENVER AREA CARBON MONOXIDE DATA

Station	Year	Period		1-hour CO observation				8-hour CO observations			
				Concentration		Occurrence		Concentration		Occurrence	
				mg/m^3	(ppm)	Date	Hour	mg/m^3	(ppm)	Date	Hour
Denver											
Camp	1971	Jan.-May, Oct.-Dec.	High	69.8	(60.9)	12/23	0800	33.3	(29.1)	12/18	1600
			2nd High	58.6	(51.1)	12/21	1700	31.6	(27.6)	12/22	1600
	1972	Jan.-Dec.	High	49.4	(43.1)	1/17	1900	33.3	(29.1)	1/7	1600
			2nd High	47.1	(41.1)	1/17	2000	31.3	(27.3)	1/17	1600
	1973	Jan.-July	High	48.3	(42.2)	1/11	1600	25.6	(22.3)	1/17	0800
			2nd High	42.5	(37.1)	1/17	1000	22.2	(19.4)	1/21	1600
2095 Julian St.	1973	Feb.-Aug., Nov.-Dec.	High	47.1	(41.1)	12/21	2100	37.1	(32.4)	12/21	1600
			2nd High	46.0	(40.2)	12/21	2200	27.6	(24.1)	11/29	1600
E. Colfax - Colo. Blvd.	1973	Feb.-Dec.	High	62.1	(54.2)	11/12	1700	26.9	(23.5)	11/18	1600
			2nd High	44.8	(39.1)	11/29	1800	26.9	(23.5)	11/29	1600
2005 S. Huron	1973	Feb.-Dec.	High	64.4	(56.2)	12/21	1900	34.1	(29.8)	12/21	1600
			2nd High	48.3	(42.2)	12/21	1800	18.4	(16.1)	12/11	1600
Arvada											
57th & Garrison	1973	Aug.-Dec.	High	32.2	(28.1)	11/29	1700	24.6	(21.5)	12/21	0800
			2nd High	32.2	(28.1)	12/21	1600	20.1	(17.5)	12/21	1600
Welby											
78th & Steele	1973	July-Dec.	High	36.8	(32.1)	12/21	1800	30.3	(26.5)	12/21	1600
			2nd High	36.8	(32.1)	12/21	2200	19.4	(16.9)	12/11	1600

ambient standards of 40 mg/m^3 (35 ppm) for one-hour and of 10 mg/m^3 (9 ppm) for eight-hours, it is clear that control measures adequate to ensure meeting the eight-hour standard will be more than adequate to ensure meeting the one-hour standard, as has been found to be generally true in all urban areas.[14]

According to current EPA procedures[13] each site is allowed one excursion above the standard per calendar year, and the percent reduction in emissions required is consequently to be determined from the second-highest concentration observed during the year. Examination of the second highest eight-hour concentrations listed in Table 30 shows that the two highest such concentrations, 31.6 mg/m^3 and 31.3 mg/m^3, occurred at the CAMP station in 1971 and 1972, respectively. The relatively low value reported for 1973 is for a partial year only and should not be taken as an indication of improving air quality. The use of 31.6 mg/m^3 in the proportional model gives a required reduction in emissions of

$$R = \frac{31.6 - 10}{31.6 - 0} \times 100 = 68 \text{ percent}$$

Carbon monoxide emission density maps calculated from traffic data, presented in Appendix L, for the Denver area show the highest concentration of emissions in the vicinity of the CAMP station (see Figure 31). It is reasonable to assume that this location is representative of maximum concentrations not only within Denver but also within the entire AQMSA with the possible exceptions of short-term concentrations near relatively narrow strips of heavily traveled highways or intersections where traffic congestion is created by indirect sources. This conclusion tends to be supported by the limited measurements made at the other sites to date. Of the five second-highest concentrations reported in Table 30 at these sites, the highest, measured at Julian Street, was 27.6 mg/m^3 and indicates a required reduction of 64 percent. The second highest such value, measured at East Colfax and Colorado Boulevard, was 26.9 mg/m^3, indicating a required reduction of 63 percent. The maximum reduction indicated at any of the remaining sites is 50 percent.

Because carbon monoxide from vehicular emissions is primarily a local problem, emissions are calculated for a three-square-mile core area of the City of Denver for use with the CAMP data in proportional modeling. From the results, an allowable emission density is calculated for general planning purposes. It must be understood, however, that an area which meets the allowable emission density requirement may still experience local problems in the vicinity of streets with exceptionally high traffic volume or with long periods of traffic congestion. The detection and elimination of such possible problem areas is a major requirement of any air quality attainment plan. However, a street-by-street analysis of the metropolitan areas within the AQMSA is beyond the scope of the present effort.

No carbon monoxide data are available for cities within the AQMSA other than for those listed in Table 30. In lieu of measurements, carbon monoxide emission densities were calculated for three of the largest cities--Boulder, Fort Collins, and Greeley--and compared with the emission density within a comparably sized central area of Denver.

The three- and twelve-square-mile core and central areas used for the Denver carbon monoxide emission calculations referred to above were chosen to correspond as closely as possible to the core and central areas referred to in an earlier study by TRW.[15]

Projected Carbon Monoxide Emissions and Ambient Concentrations

Using traffic projections, based on the JRPP transportation and land use plan, and procedures summarized in Section III (see Appendix L for details), average carbon monoxide emission densities per day were calculated at the 240 points of the Denver metropolitan grid (Appendix L, Figure L-2). Isopleths of the resulting emission densities for 1975, 1980, and 1985 have been superimposed on an outline map of Denver County and the surrounding area in Figures 29, 30, and 31, respectively. These projected emission density maps have three principal characteristics.

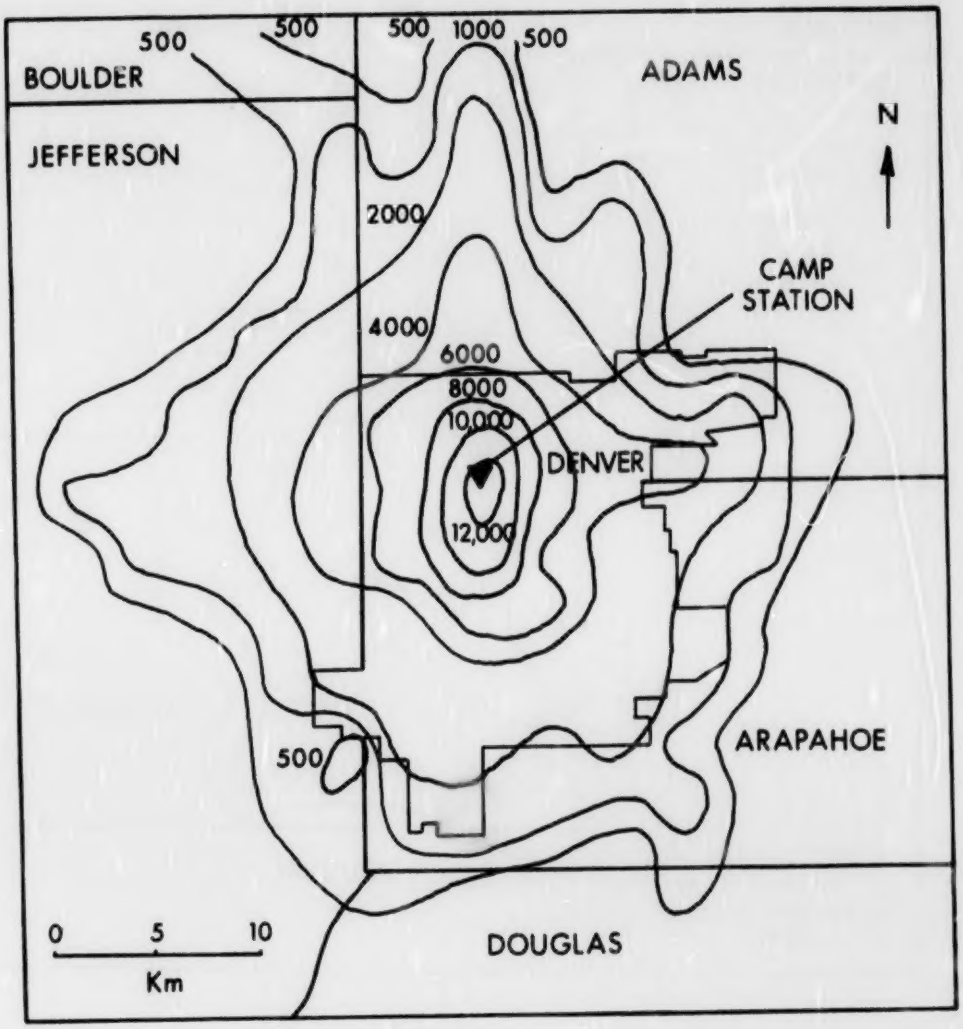
500
500
500
1000
500
BOULDER
ADAMS
N
JEFFERSON
2000
CAMP STATION
4000
6000
8000
10,000
DENVER
12,000
500
ARAPAHOE
0
5
10
Km
DOUGLAS

Figure 29. Isopleths of projected carbon monoxide emission densities from motor vehicles in Denver County and surrounding areas in 1975. Units are kg/mi^2/day.

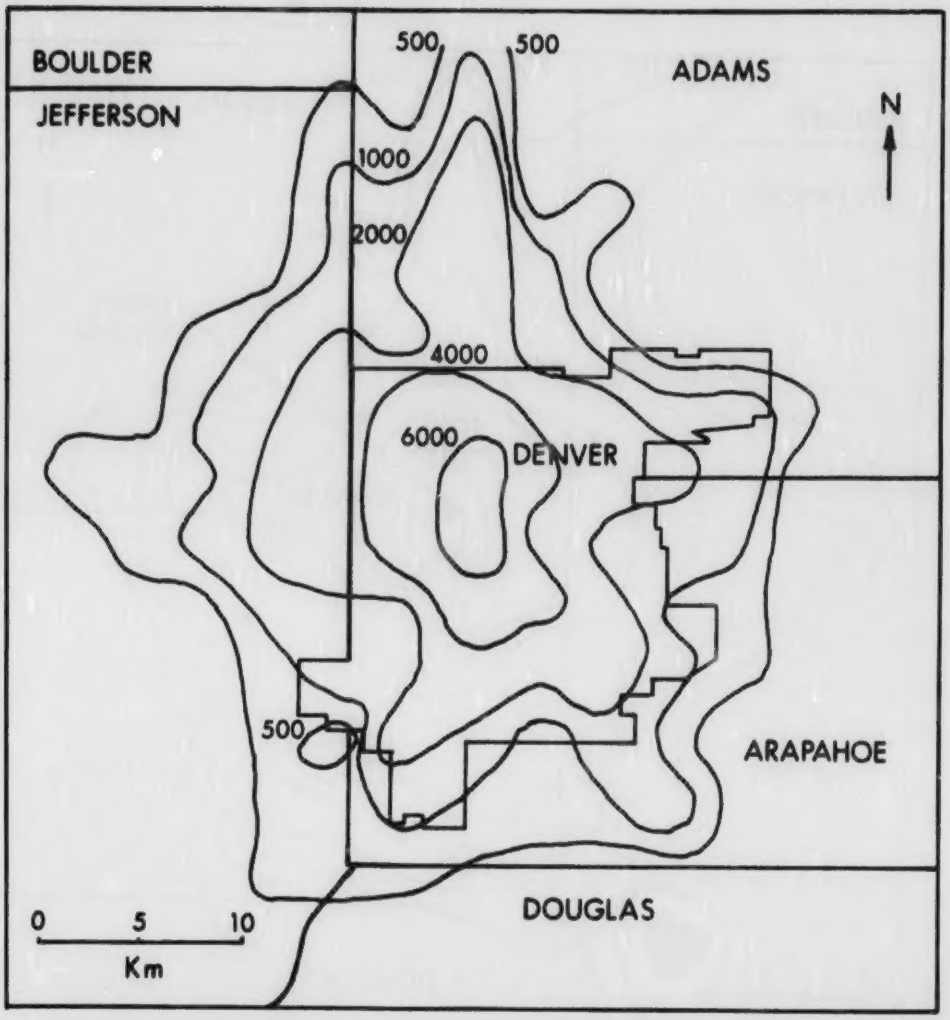
BOULDER
JEFFERSON
ADAMS
N
500
500
1000
2000
4000
6000
DENVER
500
ARAPAHOE
DOUGLAS
0
5
10
Km

Figure 30. Isopleths of projected carbon monoxide emission densities from motor vehicles in Denver County and surrounding area in 1980. Units are kg/mi^2/day.

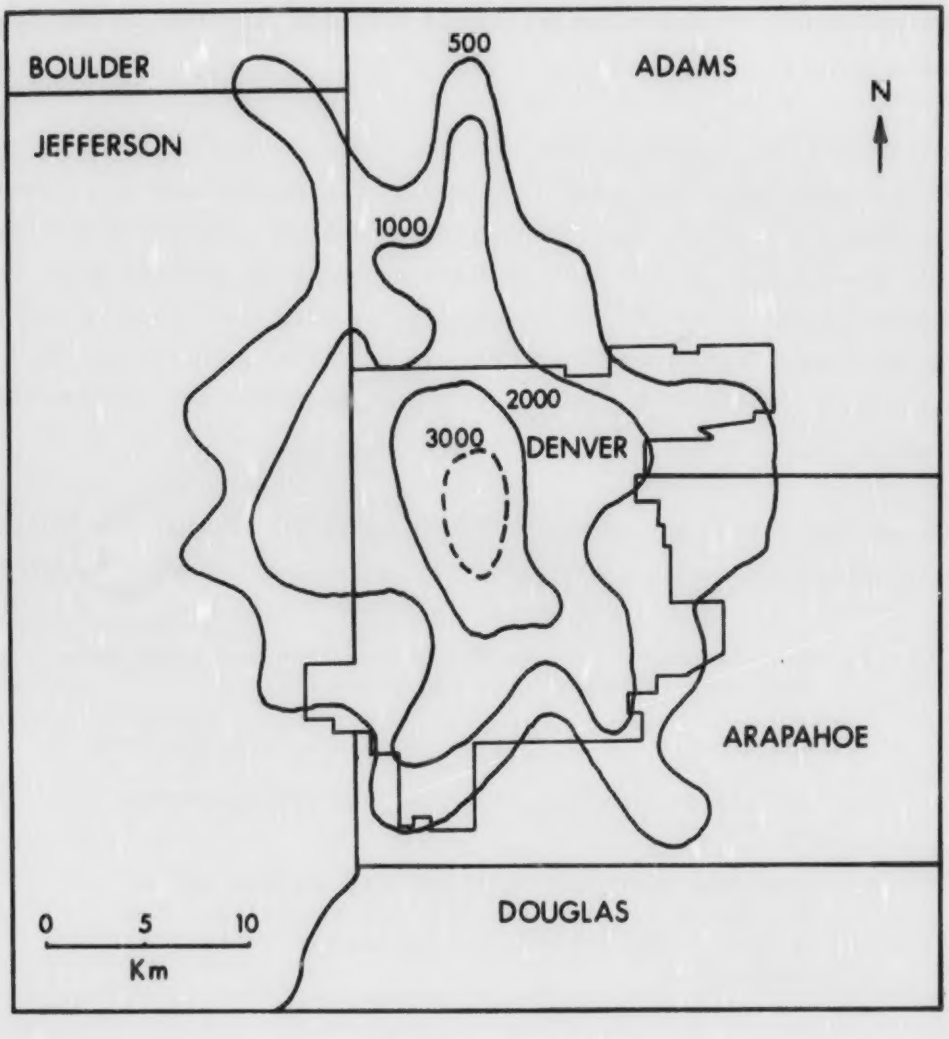
BOULDER
JEFFERSON
ADAMS
N
500
1000
2000
3000
DENVER
ARAPAHOE
DOUGLAS
0
5
10
Km

Figure 31. Isopleths of projected carbon monoxide emission densities from motor vehicles in Denver County and surrounding area in 1985. Units are kg/mi^2/day.

First, maximum emissions occur near the center of the CBD. Second, emissions within Denver decrease markedly over each five-year period. Third, emissions decrease generally throughout the entire area, indicating that reductions in average tailpipe emissions more than compensate for projected growth in vehicular traffic in all major sections of the metropolitan area.

Table 31 lists the total vehicular emissions per day expected within the three-square-mile core area of Denver at the end of each year from 1971 to 1990, calculated from traffic projections based on the JRPP plan and emissions based on continued implementation of the Federal Motor Vehicle Control Program (FMVCP). (Emission and deterioration factors for different model years under the FMVCP are given in Appendix L.) The total vehicular emissions for the years 1977 through 1985 are distributed by vehicle class in the next five columns.

According to EPA, Region VIII, it is currently felt that the following transportation control strategies can be implemented on or before 1977:

1. Semi-annual inspection and maintenance using the idle test mode (failure rate = 50 percent).
2. Air bleed retrofit on pre-1968 light duty vehicles.
3. Air bleed retrofit with exhaust gas recirculation on 1968 to 1974 light duty vehicles.
4. A maximum reduction in light duty vehicle VMT of 15 percent for all VMT-reducing strategies. (See Section V for a further discussion of these measures.)

Strategies 1, 2, and 4 were promulgated by EPA on November 7, 1973 (38 FR 30818); Strategy 3 is a proposed replacement for the high altitude modification promulgated at that time.

Table 31. CARBON MONOXIDE EMISSIONS FROM MOTOR VEHICLES WITHIN THE DENVER CORE AREA[a]

	Emissions (kg/day)													
	FMVCP with JRPP traffic projections						With strategies[b]					Additional required reduction[c]		
	Total vehicular	Light duty vehicles			HDV	Other	(LDV only)				Total all vehicles			
Year		Pre '68	'68-'74	Post '74			Pre '68	'68-'74	Post '74	Total		kg/day	% LDV	% all vehicles
1971	41,139													
1972	40,257													
1973	38,473													
1974	36,414													
1975	34,074													
1976	31,507													
1977	28,520	5,124	16,955	2,713	3,699	29	3,730	8,155	2,507	14,392	18,120	4,956	34	27
1978	25,298	3,994	14,473	3,068	3,734	29	2,908	6,962	2,835	12,705	16,468	3,304	26	20
1979	22,274	2,803	12,688	2,982	3,771	30	2,041	6,103	2,755	10,899	14,700	1,536	14	10
1980	19,120	--	12,286	2,992	3,812	30	--	5,910	2,765	8,675	12,571	0	0	0
1981	15,723	--	8,695	3,143	3,854	31	--	4,182	2,904	7,086	10,971	0	0	0
1982	14,196	--	7,111	3,193	3,861	31	--	3,420	2,950	6,370	10,262	0	0	0
1983	12,271	--	5,272	3,059	3,908	32	--	2,536	2,827	5,363	9,303	0	0	0
1984	9,677	--	2,820	2,869	3,956	32	--	1,356	2,651	4,007	7,995	0	0	0
1985	8,685	--	2,196	2,454	4,003	32	--	1,056	2,267	3,323	7,358	0	0	0
1986	7,783													
1987	6,630													
1988	6,393													
1989	5,973													
1990	5,620													

[a] Core area comprises 3 square miles.

[b] Pre '68: Semi-annual I/M using idle test mode (50% failure rate) and air bleed retrofit. Assumed reductions are respectively 7.6 and 21.2 percent.

'68-'74: Semi-annual I/M plus air bleed with exhaust gas recirculation. Assumed reductions are respectively 7.6 and 47.9 percent.

Post '74: Semi-annual I/M. Assumed reduction is 7.6 percent.

[c] Allowable emissions are assumed to be 13,164 kg/day.

An evaluation of the effectiveness of the first three strategies is in progress and the results of the very limited test data collected to date have been applied to obtain the emissions listed under the heading "With strategies" in Table 31. The percent reductions, representing best current estimates, are given at the bottom of the table. Allowable emissions for the core area are calculated by assuming that a 68 percent reduction in end-of-year 1971 emissions is required. Thus,

$$\text{Allowable Emissions} = 0.32 \times 41{,}139 = 13{,}164 \text{ kg/day}$$

and,

$$\text{Allowable Emission Density} = \frac{13{,}164}{3} = 4{,}388 \text{ kg/mi}^2\text{/day}$$

The additional required reductions shown at the right of the table should be compared to the 15 percent reduction considered feasible under Strategy No. 4. These calculations indicate that the eight-hour standard will not be achieved before the end of 1979 even with the use of the JRPP plan and the four strategies listed above; thus some modification of the current Transportation Control Plan appears to be necessary if the standard is to be achieved in 1977. On the other hand, the calculations indicate that maintenance of the standard, once it is achieved, can be accomplished principally by the JRPP plan. It is also evident from Table 31 that emissions from heavy duty vehicles play an increasingly important part in total vehicular emissions during this period, and that control of emissions from this class of vehicles could be an effective strategy. The trend in carbon monoxide emissions expected to result from the FMVCP and other control strategies shown in Table 31--and consequently the expected trend in air quality--is presented in Figure 32.

It should be pointed out that emissions in Table 31 have been entered to the nearest kg/day to illustrate trends and relative contributions, and to avoid confusion due to roundoff. This apparent precision should not be taken as an indication of the accuracy of the prediction methodology.

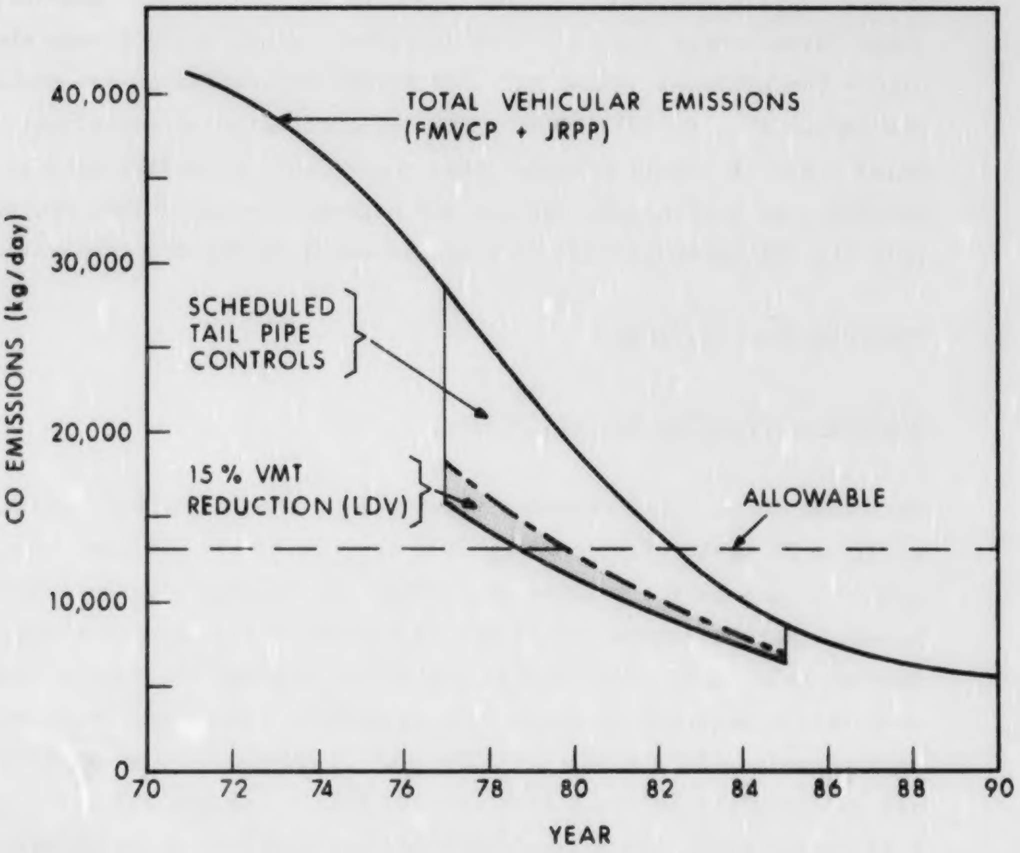

Figure 32. CO emissions within Denver core area

Figure 33 is a plot of city-wide carbon monoxide emission density within Fort Collins (7.362 mi^2), Boulder (13.092 mi^2), and Greeley (9.185 mi^2) with that of the twelve-square-mile central area of Denver used for comparison. These projections are based on the JRPP plan and the FMVCP and do not contain the effect of the promulgated strategies. Examination of these curves shows that emission densities within these cities should be within the allowable value of 4,388 kg/mi^2/day estimated for Denver throughout 1975 to 1985 without the implementation of additional strategies. But it should be noted that the effects of differences in topography, city structure, street and highway configuration, and meteology are not accounted for by a simple emission density comparison.

PHOTOCHEMICAL OXIDANTS

Summary of Observed Concentrations

Measurements of total oxidants were made at the Denver CAMP station by the alkaline KI method from 16 July 1970 through 19 May 1971 and from 1 October 1971 through the remainder of 1971. The analysis method was changed to calorimetric neutral KI at the beginning of 1972 and continued as such through July 1973. The highest and second highest one-hour average concentrations measured by these methods during these three years were, respectively: 1971 - 392 and 353 $\mu g/m^3$ (0.20 and 0.18 ppm); 1972 - 353 and 333 $\mu g/m^3$ (0.18 and 0.17 ppm); and 1973 - 235 and 235 $\mu g/m^3$ (0.12 and 0.12 ppm). Using the relationship between hydrocarbon emissions and ambient photochemical oxidant concentration as defined in Appendix J, 40 CFR Part 51 (36 FR 15502) and an oxidant concentration of 353 $\mu g/m^3$ (0.18 ppm) yields a required reduction in hydrocarbon emissions of 60 percent, which is the value used for transportation control promulgation by EPA in November 1973 (38 FR 30818).

In 1973 measurements were begun at the CAMP station using the approved chemiluminescence method, and five additional sites using this method were also activated within the Denver area by the state. The results are shown in Table 32. The second highest one-hour concentration observed at any of these locations was 490 $\mu g/m^3$ (0.25 ppm). Careful examination of

Table 32. DENVER AREA OXIDANT DATA OBTAINED IN 1973 BY CHEMILUMINESCENCE

			1-hour O_3 observations			
			Concentration		Occurrence	
Station	Sampling period		$\mu g/m^3$	(ppm)	Date	Hour
Denver						
Camp	Jan.-July	High	176	(0.09)	3/21	12 N
		2nd High	176	(0.09)	6/29	1600
2095 Julian St.	Aug., Nov.-Dec.	High	519	(0.26)	8/13	1400
		2nd High	470	(0.24)	8/13	1300
E. Colfax & Colo. Blvd.	July-Dec.	High	319	(0.16)	8/13	1300
		2nd High	304	(0.15)	8/13	12 N
2005 S. Huron	Aug.-Dec.	High	343	(0.17)	12/22	1300
		2nd High	323	(0.16)	8/13	1700
Arvada						
57th & Garrison	Aug.-Dec.	High	500	(0.25)	8/13	1400
		2nd High	490	(0.25)	8/13	1500
Welby						
78th & Steele	July-Dec.	High	392	(0.20)	8/9	1000
		2nd High	343	(0.17)	8/15	0800

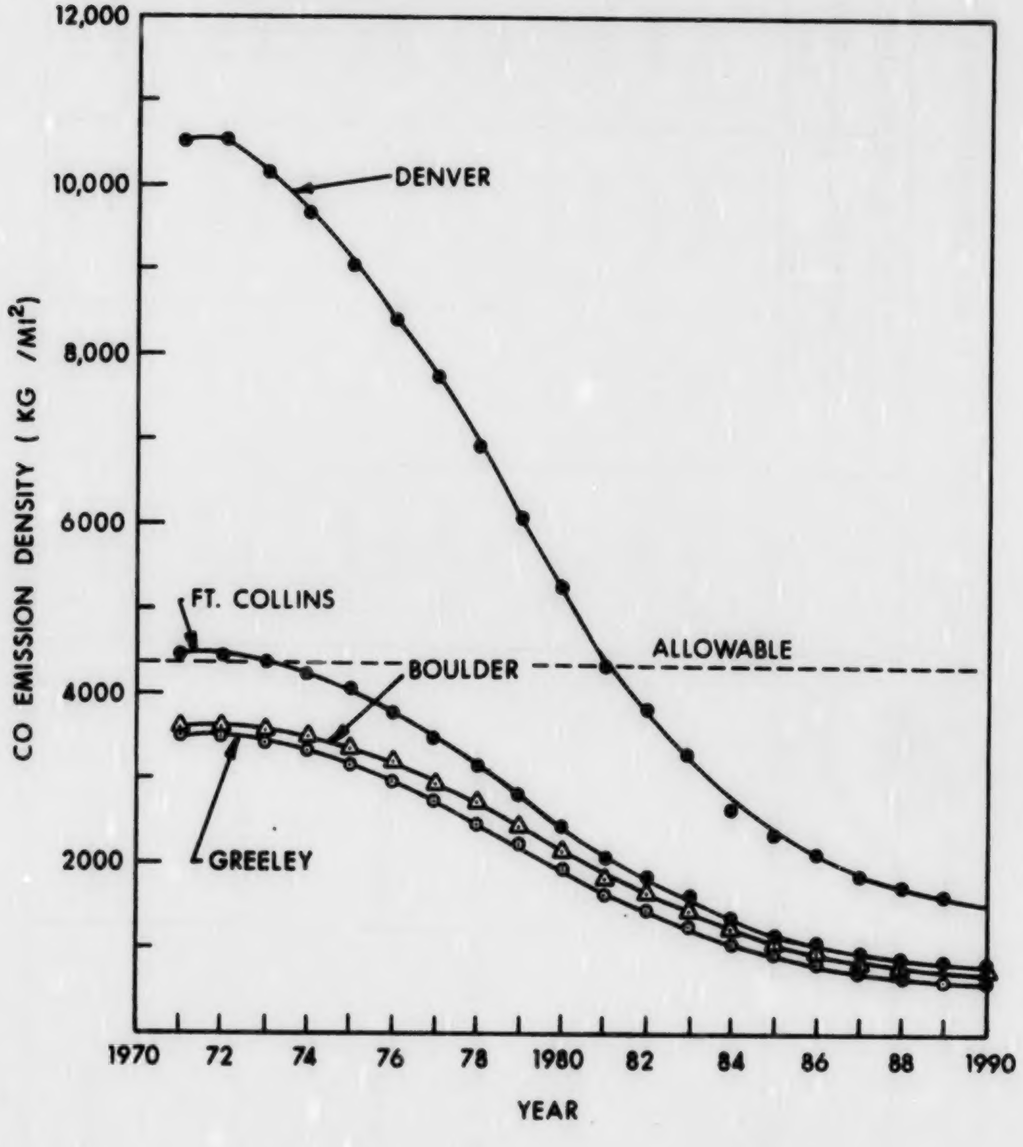

Figure 33. Carbon monoxide emission densities for four cities in the Denver AQMSA.

all 1973 data plus more recent data may show that the high levels reached within the area on 13 August were episodic in nature and that a lower value than 490 $\mu g/m^3$ could properly be used for long range planning. Also, as comprehensive data from the expanded network becomes available, the use of a more broadly based index than the currently recommended[13] second highest one-hour concentration may become appropriate for rollback calculations. However, unless subsequent developments indicate otherwise, reduction estimates should be based on the observed value of 490 $\mu g/m^3$ in line with the current EPA guidelines. The use of 490 $\mu g/m^3$ in conjunction with Appendix J yields a required reduction in hydrocarbons of approximately 82 percent. The use of a straight percentage rollback would require a reduction of approximately 67 percent. Because of serious uncertainties in using Appendix J with high pohtochemical oxidant values, EPA has allowed states to use Appendix J type relationships derived from local data or to employ linear rollback--hence, since no Denver Appendix J has been developed, the rollback estimate will be used to estimate allowable emissions in the discussion which follows.

Hydrocarbon Emissions and Ambient Oxidant Concentrations

Figures 34, 35, and 36 are hydrocarbon emission density maps for the Denver area based on projected vehicular emissions for 1975, 1980, and 1985, respectively. As was the case with carbon monoxide, the maximum emissions occur near the CBD and the trend is for reduced emissions throughout the area.

Table 33 lists the total daily vehicular emissions by year for the 960-square-mile Denver metropolitan area calculated from traffic projections based on the JRPP transportation and land use plan and emissions based on the FMVCP. These total emissions are then broken down by vehicle type for the years 1977 to 1985 in the next five columns. The emissions expected after the currently planned transportation control strategies (see discussion, page 162) are shown under the heading 'With Strategies." In contrast to carbon monoxide, non-vehicular sources contribute substantial amounts of hydrocarbons to the Denver area. Consequently, emissions from

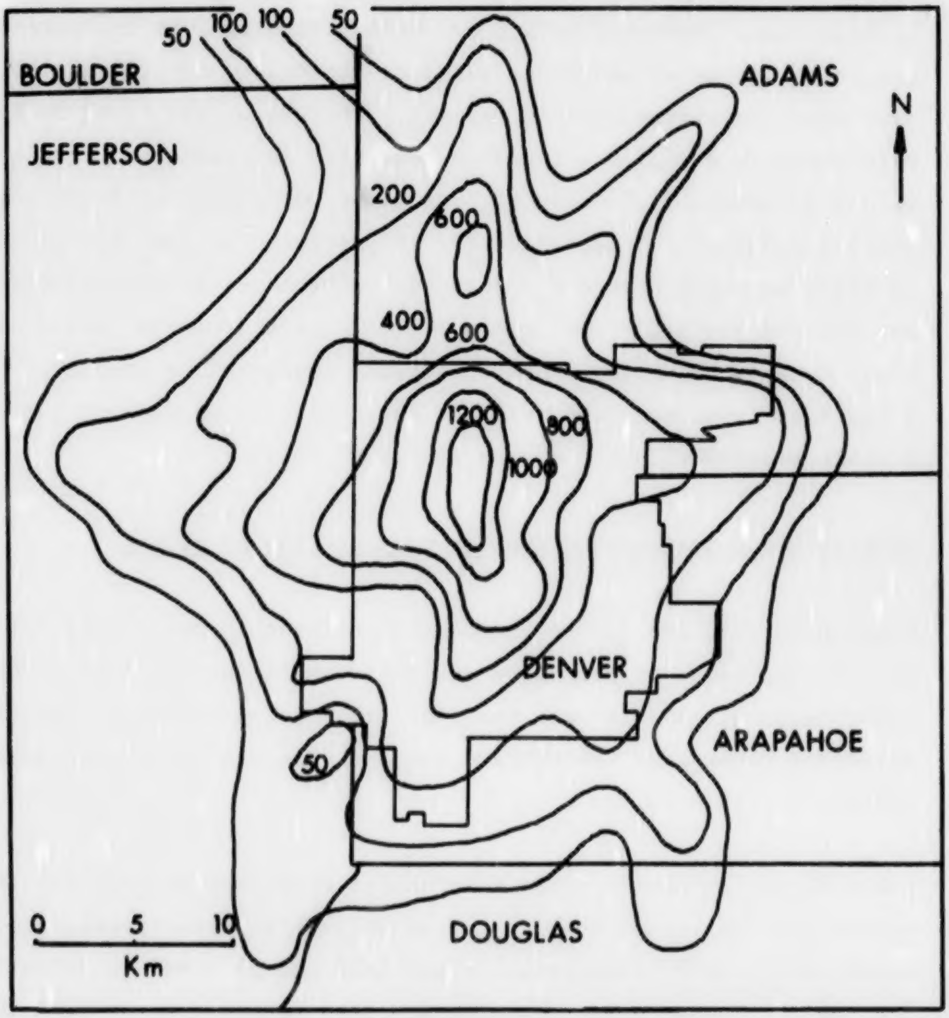
50
100
100
50
BOULDER
ADAMS
N
JEFFERSON
200
800
400
600
1200
800
1000
DENVER
ARAPAHOE
50
0
5
10
Km
DOUGLAS

Figure 34. Isopleths of projected hydrocarbon emission densities from motor vehicles in Denver County and surrounding area in 1975. Units are kg/mi^2/day.

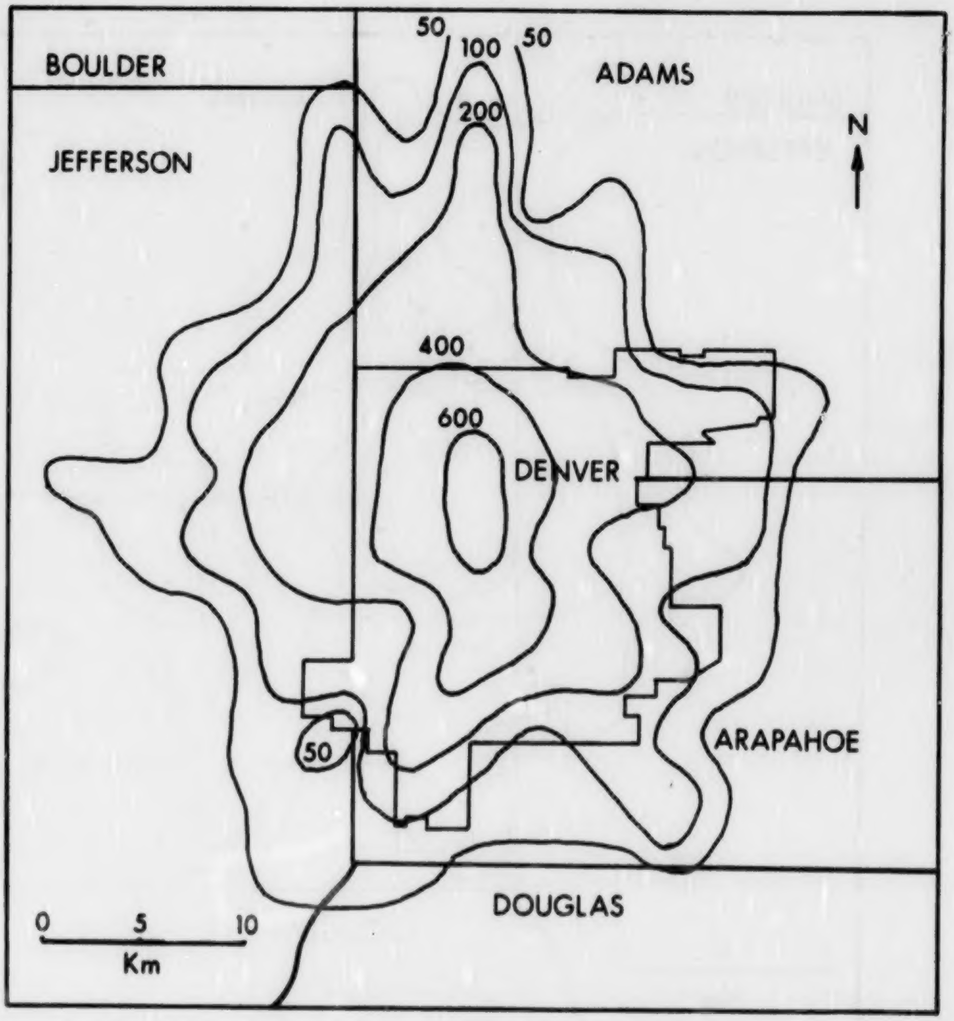
50
100
50
BOULDER
ADAMS
200
N
JEFFERSON
400
600
DENVER
50
ARAPAHOE
0
5
10
Km
DOUGLAS

Figure 35. Isopleths of projected hydrocarbon emission densities from motor vehicles in Denver County and surrounding area in 1980. Units are kg/mi^2/day.

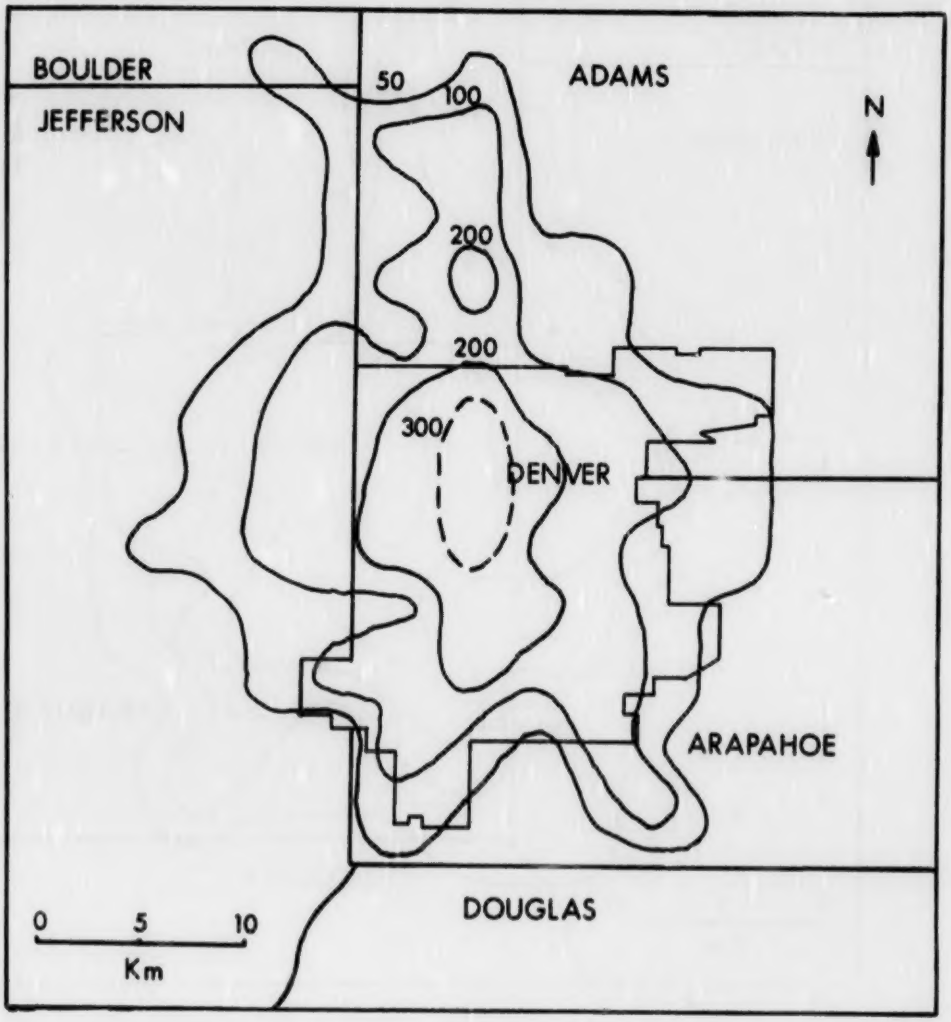
BOULDER
JEFFERSON
ADAMS
N
50
100
200
200
300
DENVER
ARAPAHOE
DOUGLAS
0
5
10
Km

Figure 36. Isopleths of projected hydrocarbon emission densities from motor vehicles in Denver County and surrounding area in 1985. Units are kg/mi^2/day.

Table 33. HYDROCARBON EMISSIONS WITHIN THE DENVER METROPOLITAN AREA[a]

	Emissions (kg/day)														
	FMVCP with JRPP traffic projections						With strategies[b] (LDV only)				Stationary emissions[c]	Vehicular plus stationary	Additional required reduction[d]		
	Total vehicular	LDV			HDV	Other									
Year		Pre '68	'68-'74	Post '74			Pre '68	'68-'74	Post '74	Total			kg/day	% LDV	% all vehicles
1971	154,939										54,162	209,101			
1972	149,455										54,162	203,617			
1973	143,558										54,162	197,720			
1974	137,209														
1975	127,045														
1976	117,100														
1977	106,618	21,817	59,882	9,485	15,253	181	15,000	43,983	8,404	67,387	13,703	96,524	30,303	45	37
1978	96,798	17,398	52,325	11,408	15,479	188	11,962	38,432	10,107	60,501	13,703	89,871	23,650	39	31
1979	86,915	12,481	46,302	12,214	15,723	195	8,581	34,009	10,822	53,412	13,703	83,033	16,812	31	24
1980	74,611	--	45,583	13,271	15,555	202	--	33,480	11,758	45,238	13,703	74,698	8,477	19	14
1981	66,354	--	35,459	14,763	15,922	209	--	26,044	13,080	39,124	13,703	68,958	2,737	7	5
1982	59,856	--	27,627	15,764	16,249	216	--	20,292	13,967	34,259	13,703	64,427	0	0	0
1983	50,782	--	17,825	16,057	16,677	223	--	13,092	14,226	27,318	13,703	57,921	0	0	0
1984	45,281	--	11,864	16,059	17,128	230	--	8,714	14,228	22,942	13,703	54,003	0	0	0
1985	42,266	--	9,389	15,058	17,582	237	--	6,896	13,341	20,237	13,703	51,759	0	0	0
1986	39,166														
1987	34,833														
1988	34,583														
1989	33,747														
1990	32,699														

[a] Metropolitan area comprises 960 square miles.

[b] Pre '68: Semi-annual I/M using idle test mode and air bleed retrofit. Assumed reductions are respectively 11.4 and 22.4 percent.

'68-'74: Semi-annual I/M plus air bleed with exhaust gas recirculation. Assumed reductions are respectively 11.4 and 17.1 percent.

Post '74: Semi-annual I/M. Assumed reduction is 11.4 percent.

[c] 1972 HC stationary source emissions are assumed to have the effectiveness used in EPA plan (38FR30819).

[d] Allowable emissions = 66,221 kg/day.

these stationary sources must be considered when projecting air quality. In Table 33 it has been assumed that the ratio of stationary emissions (plus aircraft) to vehicular emissions given by the 1972 NEDS inventory for the Denver AQCR applies to the 960-square-mile area. It has also been assumed that the regulations introduced for the control of stationary sources will have the overall effectiveness indicated by the Colorado Transportation and Land Use Plan[16] and by the EPA-promulgated transportation control plan. The additional reduction in hydrocarbon emissions required from VMT-reducing strategies, based on a reduction of 67 percent, is shown at the right of the table. In making these estimates, the allowable emissions were calculated from mid-1973 vehicular and stationary source emissions as follows:

$$0.33 \times \frac{(203{,}617 + 197{,}720)}{2} = 66{,}221 \text{ kg/day}$$

The results shown at the right of Table 33 indicate that the ambient oxidant standards will not be met until 1982 simply by the use of the planned inspection and maintenance and retrofit programs even if the JRPP plan is followed. Table 33 further shows that the additional reduction required beyond that provided by these programs, when expressed as a reduction in light-duty VMT, exceeds the 15 percent expected from currently promulgated plans (38 FR 30820) until sometime in 1981. Once attainment is achieved, however, maintenance can be seen to follow as a matter of course due to the reducing emissions from vehicular sources. Figure 37 presents the emission trend data from Table 33.

NITROGEN OXIDES

Summary of Observed Concentrations

The only reported set of nitrogen dioxide measurements made with a currently acceptable analytical method that is also statistically adequate for the determination of an annual mean was collected at the CAMP station in Denver in 1972. The annual arithmetic mean obtained from 6759

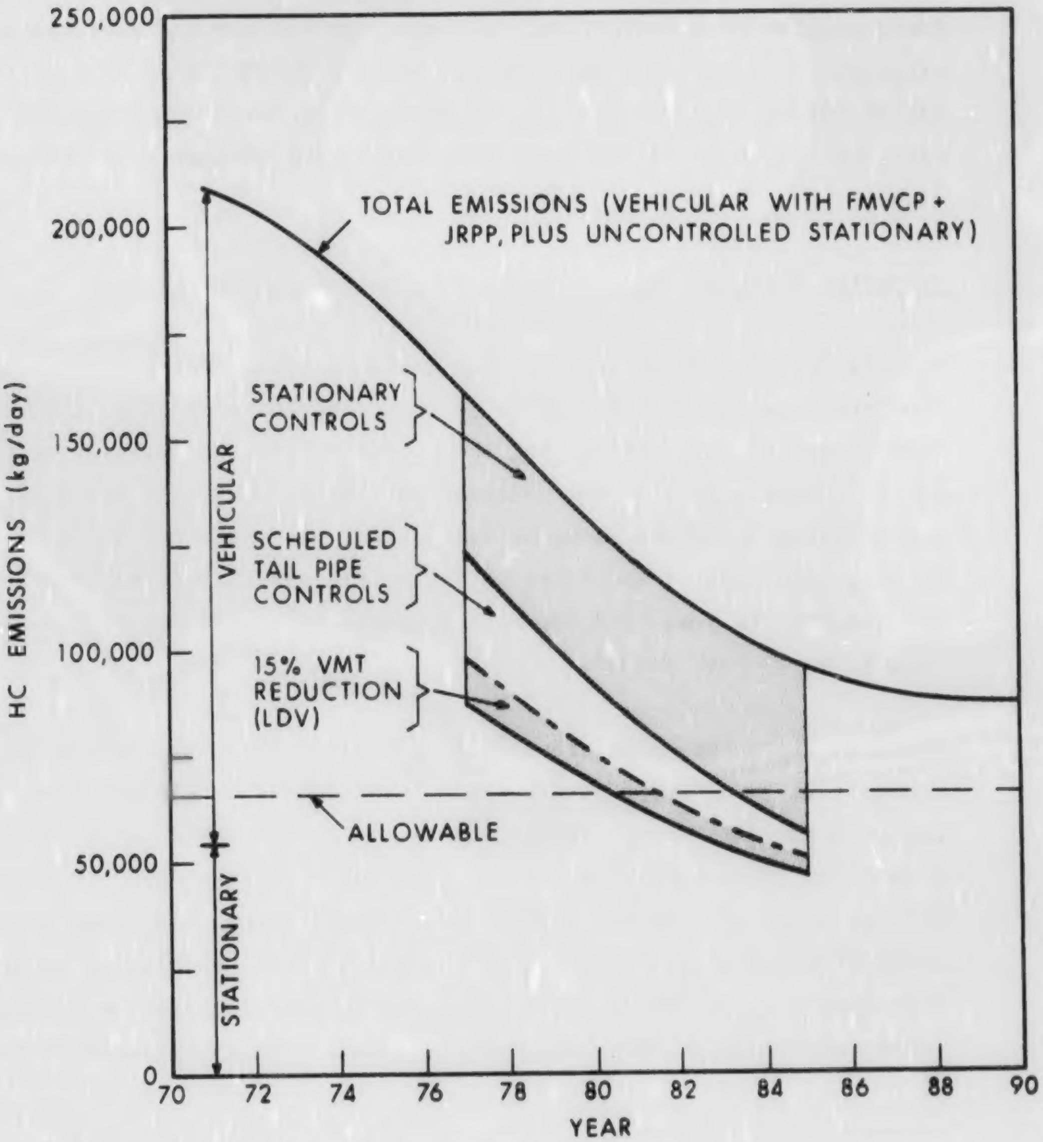

Figure 37. HC emissions within Denver metropolitan area

one-hour observations made by an instrumental colorimetric method during the year was 73 $\mu g/m^3$, substantially lower than the national ambient standard of 100 $\mu g/m^3$.* Other data collected in Denver as part of the field program to reevaluate the reference method for the measurement of nitrogen dioxide, and summarized in the June 8, 1973 Federal Register (38 FR 15174), suggest that the annual average does not exceed the standard, but are too limited to provide meaningful estimates of the annual mean.

Projected Emissions and Concentrations of Nitrogen Oxides

Figures 38, 39, and 40 are nitrogen oxide emission density maps calculated from projected vehicular sources in the Denver area in 1975, 1980, and 1985, respectively. Reflecting the annual changes in emission factors, little change occurs in the emission pattern between 1975 and 1980 but a marked decrease in the emission level takes place between 1980 and 1985. No area with significantly increasing emissions--indicating deteriorating air quality--is predicted due to the projected changes in vehicular travel during the 10-year period.

Table 34 lists the calculated daily vehicular emissions for the 960-square-mile Denver metropolitan area, broken down by vehicle type, for the period from 1971 through 1980. Inspection of the table shows that emissions from light duty vehicles increase until 1977 and then decrease through 1990, but remain essentially constant between 1975 and 1980. Emissions from heavy duty vehicles and diesel powered vehicles increase slowly from year to year reflecting a projected regular increase in traffic from these relatively uncontrolled vehicle types. The two columns at the right

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*It is the opinion of EPA, Region VIII, that annual means determined from CAMP station data by the Saltzman Colorimetric Technique will also be accepted as valid after further investigation. For the period 1965-1972, annual means based on this method are available for 5 years and are: 1965 - 68 $\mu g/m^3$; 1966 - 64 $\mu g/m^3$; 1969 - 62 $\mu g/m^3$; 1970 - 72 $\mu g/m^3$; and 1972 - 73 $\mu g/m^3$.

Table 34. VEHICULAR EMISSIONS OF NITROGEN OXIDES WITHIN DENVER METROPOLITAN AREA[a]

Year (31 Dec)	Emissions (kg/day)					
	FMVCP with JRPP traffic projections				With strategies[b]	
	Total	LDV	HDV	Other	LDV	Total
1971	37,987	33,222	3909	856		
1972	41,580	36,584	4098	898		
1973	43,653	38,428	4285	939		
1974	44,518	39,063	4474	981		
1975	44,996	39,310	4663	1023	33,413	39,100
1976	45,711	39,815	4835	1061	33,843	39,739
1977	46,176	40,046	5028	1103	34,039	40,170
1978	46,027	39,660	5222	1145	33,711	40,078
1979	46,153	39,549	5417	1187	33,617	40,221
1980	46,174	39,332	5613	1229	33,432	40,274
1981	44,785	37,704	5809	1271	32,048	39,128
1982	41,918	34,610	5994	1313	29,418	36,725
1983	39,762	32,216	6191	1355	27,384	34,930
1984	37,571	29,784	6389	1398	25,316	33,103
1985	34,198	26,172	6586	1440	22,246	30,272
1986	32,845	24,582	6782	1481		
1987	31,680	23,181	6976	1523		
1988	30,016	21,278	7172	1564		
1989	29,284	20,309	7369	1606		
1990	28,667	19,456	7563	1648		

[a] Metropolitan area comprises 960 square miles.

[b] 15 percent reduction in light-duty vehicle VMT.

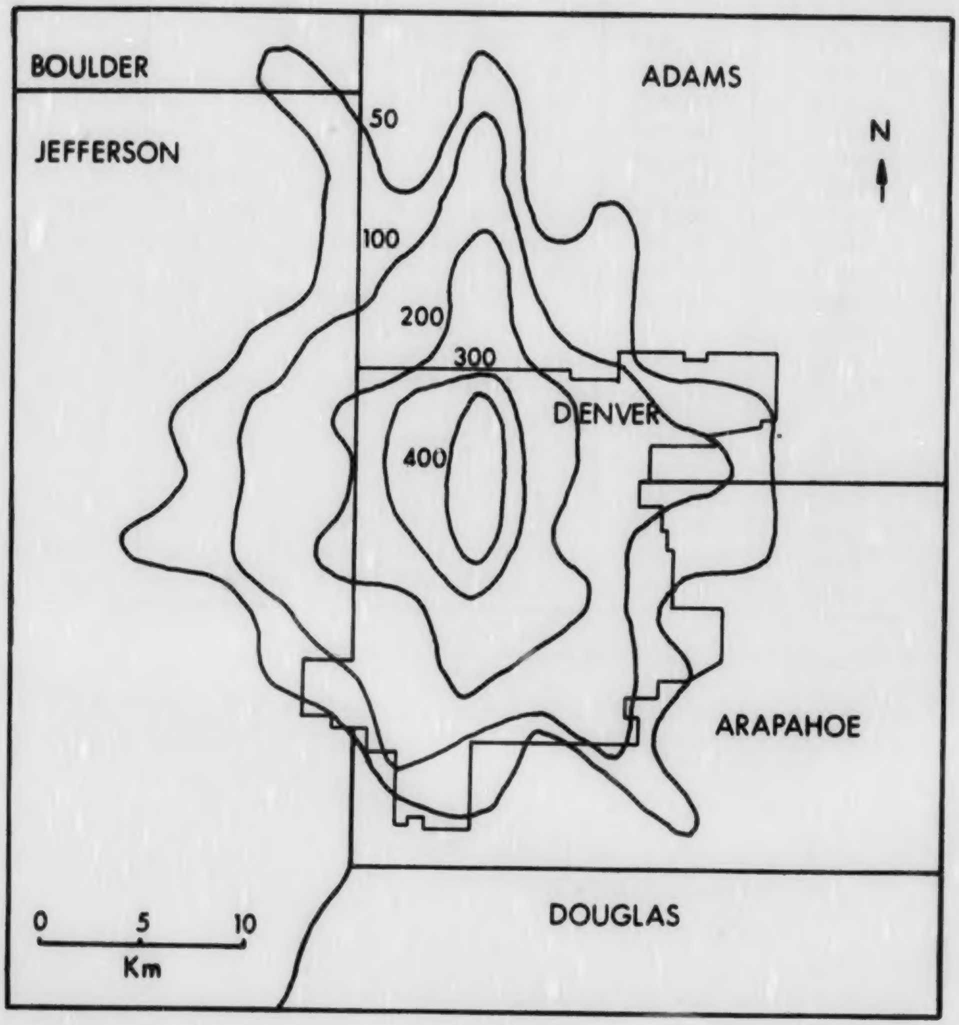
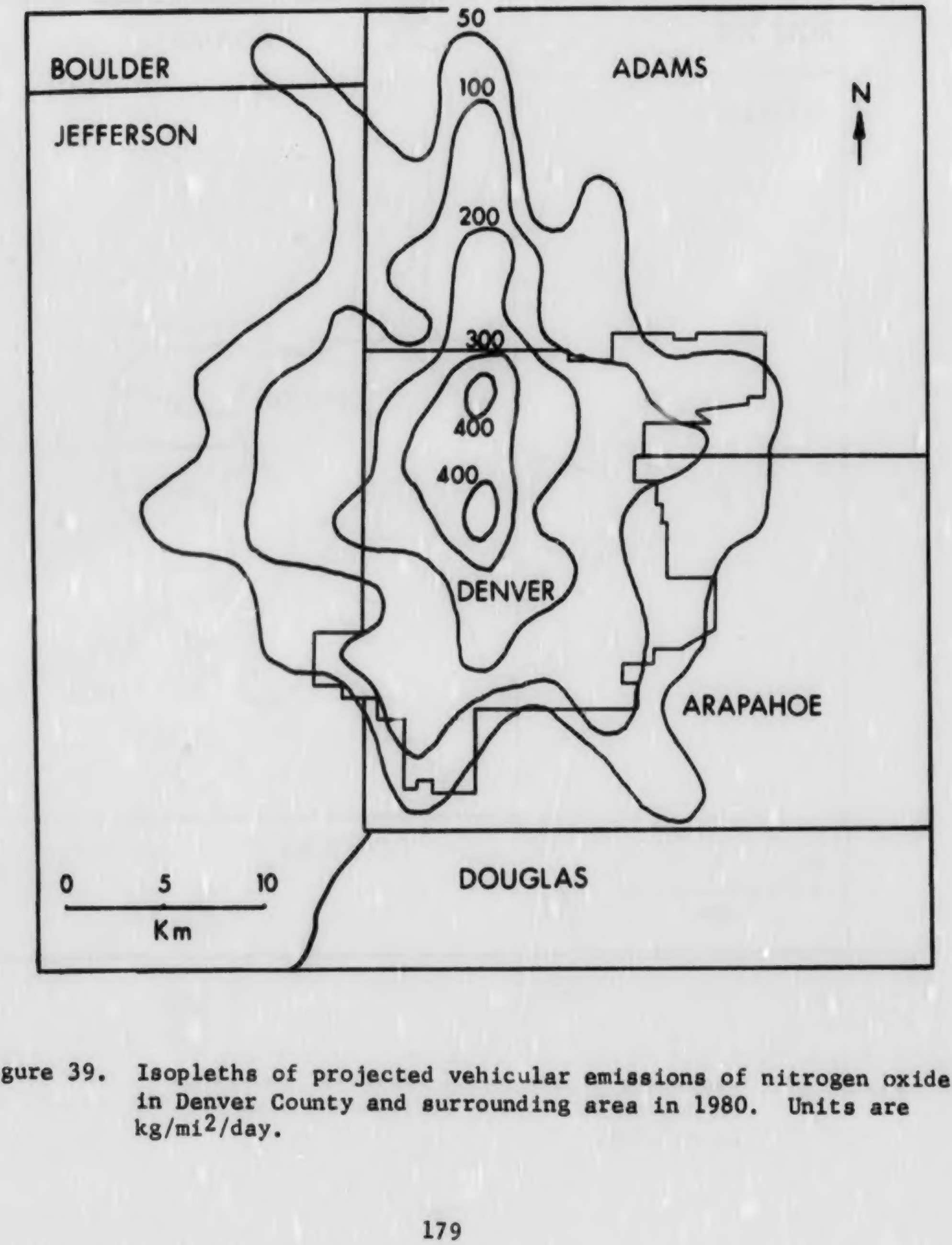
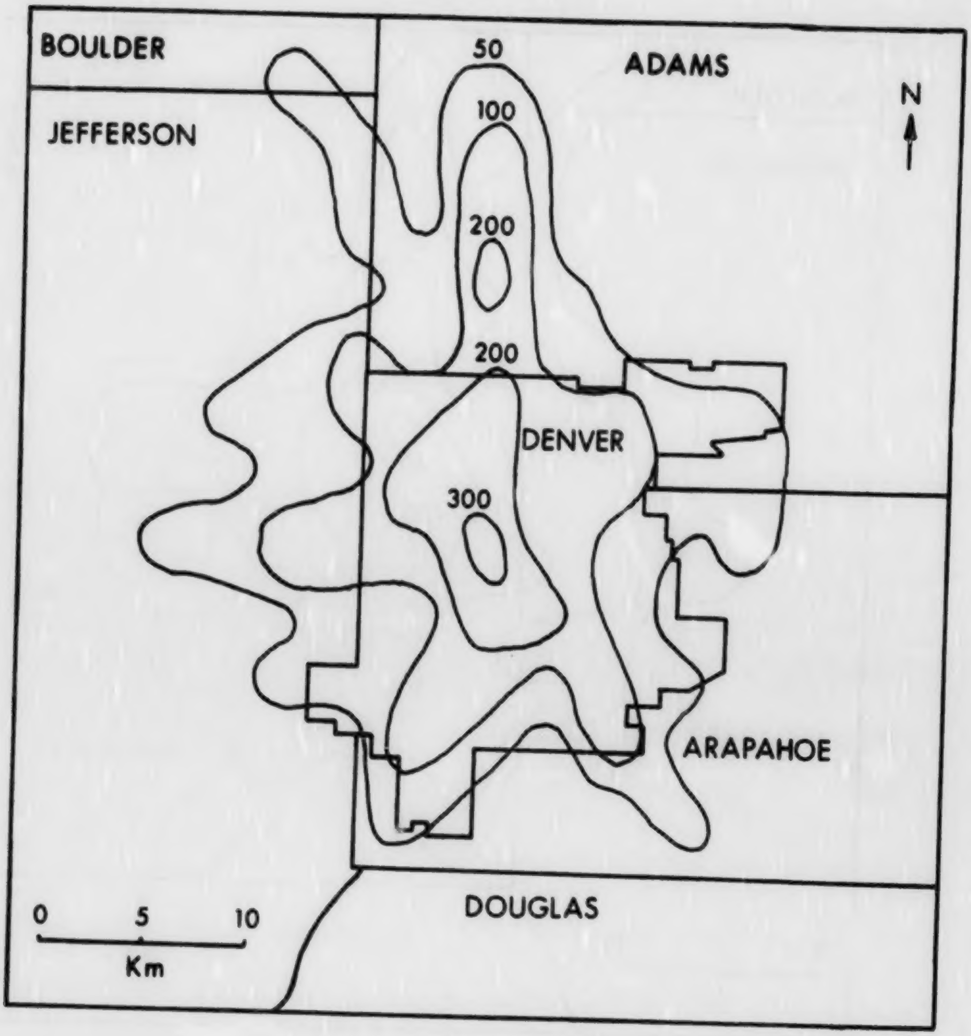

BOULDER
ADAMS
JEFFERSON
N
50
100
200
300
DENVER
400
ARAPAHOE
DOUGLAS
0
5
10
Km

Figure 38. Isopleths of projected vehicular emissions of nitrogen oxides in Denver County and the surrounding area in 1975. Units are kg/mi^2/day.



50
100
200
300
400
400
BOULDER
ADAMS
JEFFERSON
N
DENVER
ARAPAHOE
DOUGLAS
0
5
10
Km

Figure 39. Isopleths of projected vehicular emissions of nitrogen oxides in Denver County and surrounding area in 1980. Units are kg/mi^2/day.


BOULDER
JEFFERSON
ADAMS
N
50
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200
200
DENVER
300
ARAPAHOE
DOUGLAS
0
5
10
Km

Figure 40. Isopleths of projected vehicular emissions of nitrogen oxides in Denver County and surrounding area in 1985. Units are kg/mi^2/day.

in the table show the effect of the 15 percent decrease in light-duty-vehicle VMT assumed to be achievable under the existing transportation control plans (38 FR 30820). The maximum total vehicular emissions predicted under these assumptions is 40,170 kg/day and is approximately that calculated for the year 1972 when the annual mean nitrogen dioxide concentration was 73 percent of the standard. These calculations therefore indicate that a substantial increase in emissions from other sources could be tolerated without exceeding the standards. For example, the 1972 NEDS inventory for the Metropolitan Denver AQCR shows that emissions from non-vehicular sources are approximately equal to those from highway vehicles. Consequently, emissions from these non-vehicular sources could increase at an annual rate of about 6.5 percent between 1972 and 1980 when vehicular emissions start decreasing, without exceeding the allowable emissions for the area of 108,996 kg/day.* In contrast, emissions of nitrogen oxides from non-vehicular sources, excluding power plants, are estimated to increase at less than 2 percent per year, and no additional major power plants are currently scheduled for the metropolitan area according to EPA, Region VIII. Therefore, barring the introduction of currently unscheduled major uncontrolled sources, no violation of the nitrogen dioxide standard is indicated during the forecast period.

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*Allowable emmissions = twice the vehicular emission rate for mid-1972 (37,987 + 41,580) divided by 0.73, or 108,996 kg/day. Acceptable growth rate obtained from $P = \frac{A_n}{(1 + R)^n}$ where P = 41,580, A_n = (108,996 - 40,274) and n = 8.

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SECTION V

CONTINGENCY ATTAINMENT STRATEGIES

INTRODUCTION

The attainment strategy is considered separately from the maintenance strategy due to the different thrust of their control measures. Attainment measures are primarily directed at the reduction of emissions from existing sources, either by a direct control on the emissions themselves (e.g., a process rate or fuel content regulation), or by reducing the number of certain types of sources of emissions (e.g., banning open burning, VMT reductions). Maintenance measures, on the other hand, are aimed at controlling the growth of emissions which would bring about an infraction of the air quality standards. Such measures are then directed at controlling the amount of growth, either the growth directly (e.g., zoning approvals) or the emissions from the growth (e.g., New Source Performance Standards), or the location of the future sources (e.g., emission density zoning, regional development planning).

For the State of Colorado, attainment measures operate to reduce concentrations to the National Ambient Air Quality Standards within the timeframe of the 1977 deadline. Maintenance measures, however, are directed at the following period of time though they are also continuously applicable from the time of implementation.

The projections of concentrations in the previous section demonstrated that, given previously quantified control regulations and air quality trends, the primary and secondary standards of total suspended particulates, carbon monoxide, and photochemical oxidants would not be achieved by the specified attainment dates. Since the attainment of the desired air quality is an integral part of the Air Quality Maintenance Plan development, it is essential to discuss those measures which must be implemented to ensure attainment of the standards.

This section discusses transportation control measures and fugitive dust control measures as a contingency attainment strategy package. The measures are presented as a means of ensuring the effectiveness and integrity of the Colorado SIP as well as the AQMP supplement to the plan.

TRANSPORTATION CONTROLS

Promulgated Transportation Control Plan

The U.S. Environmental Protection Agency (EPA) promulgated a Transportation Control Plan (TCP) for the Denver area in the Federal Register on 7 November 1973. The promulgated TCP includes several elements:

1. Program for inspection and maintenance of motor vehicles, using the idle test mode, to be fully implemented by 1 December 1975.
2. Program for equipping of pre-1968 model year vehicles with engine air bleed devices, to be implemented by 1 July 1976.
3. Program for modification of 1968-1975 model year vehicles for high altitude, to be implemented by 1 July 1976.
4. Program for control of hydrocarbon emissions from stationary transportation, manufacturing, and processing facilities.
5. Creation of bus-carpool lanes on existing roadways.
6. Limitation on construction of parking facilities, to be implemented on 1 January 1975.

7. Removal of on-street parking in the Denver Central Business District (CBD).

8. Mass transit improvements.

9. Limitation on gasoline sales.

The last measure, namely the limitation of gasoline sales, was imposed by EPA because the other measures are not expected to achieve as much reduction in carbon monoxide emissions as is considered necessary to meet the ambient air quality standards by the extended deadline of 31 May 1977. Carbon monoxide emissions were then thought to require a 64 percent reduction (from 1971 emissions); the gasoline limitation was estimated to provide for a 6 percent reduction.

Section IV of this report discusses the present expectations of the need for reducing emissions. It is indicated in Section IV that EPA Region VIII now expects the TCP to be amended to include slightly different measures for inspection and maintenance and for modification of existing automobile engines. The air quality estimates in that section reflect this fact.

As shown in Tables 31 and 33, transportation control measures must be able to reduce light duty vehicular travel by 34 percent to meet CO standards and by 45 percent to meet applicable oxidant levels. Since the first four transportation control measures listed have already been incorporated into the air quality projection, the necessary reduction must be achieved by the latter five measures.

In response to the EPA-promulgated TCP, the Air Pollution Control Commission recently promulgated Regulation number 9 which deals explicitly with measures 5 through 8 mentioned above. (It should be noted that as of this writing this regulation has neither been approved by the Attorney General of Colorado nor accepted by the EPA). Elements of Regulation number 9 are:

1. Exclusive Bus-Carpool Lanes, to be implemented by 1 January 1976.
2. Creation of Park-N-Ride Facilities with express buses to the CBD; with plan submission by 1 October 1974.
3. Carpooling programs, to be implemented by large employers (> 250 employees) by 1 April 1975, and by other employers (50 to 250 employees) by 1 October 1975. In addition, employers must submit a description of incentives which encourage employees to make use of mass transit facilities. Large employers must submit their plan by 1 February 1975, with submittal by other employers by 1 August 1975.

In addition, the regulation requires that DRCOG submit recommendations to the APCC by 1 March 1975 on parking requirements that may stimulate the use of public transportation and decrease single passenger VMT.

As these latter control measures have only recently been promulgated and are currently in the development stages, it is not yet possible to precisely quantify the emission reduction potential of the measures. If, however, the maximum possible expected reduction in VMT, estimated by EPA Region VIII, is attained under these regulations, only a 15 percent reduction is possible. This indicates that a further reduction of 30 percent in VMT is required to meet the photochemical oxidant standard. This is equivalent to a reduction of 10 percent in the hydrocarbon emissions from the 1971 level. For carbon monoxide the additional reduction needed in light-duty VMT and total emissions from the 1971 level is 19 and 7 percent, respectively. This implies that the control of hydrocarbon emissions will also bring about the needed control of carbon monoxide emissions if parallel reduction measures are pursued.

As mentioned above, the TCP promulgated by EPA imposed gasoline sales restrictions to provide for an additional 6 percent reduction in CO emissions from the 1971 levels. These limitations also provide a 5 percent reduction in hydrocarbon emissions. From the above analysis it is evident that, since maximum feasible controls have already been placed on the sources themselves, the gasoline limitation will have to be doubled to provide for the additional 10 percent reduction in hydrocarbon emissions.

An estimate of the impact of such a measure can be better determined from considering the actual reductions in emissions from the projected 1977 levels instead of the 1971 emission levels presented above for control measure evaluation. It has already been stated that these reductions would be comparable to a 30 percent reduction in VMT in 1977. From Table 33, it can be demonstrated that this is equivalent to 21 percent of all hydrocarbon emissions and 24 percent of all vehicular emissions projected for 1977.

Since the impact of such a measure is potentially onerous from a social and economic standpoint, no specific regulations for the implementation of this measure are proposed at this time. Instead, continued monitoring of air quality and investigation of alternative measures will be increased. It is possible that greater than the 15 percent VMT reduction may be achieved by the state through the currently promulgated regulations or additional measures which may be implemented by the state, or that such a large VMT reduction may prove to be unnecessary based upon 1976 air quality data.

The extent of any gasoline sales limitation is contingent upon the determination of the effect of the currently promulgated transportation control plan, with its supporting regulations, on the air quality. As EPA's gasoline sales limitation regulation requires the state to make this determination on the basis of data collected during fiscal year 1976, no further regulations to ensure continued evaluation are needed at this time.

FUGITIVE DUST CONTROLS

Promulgated Fugitive Dust Control Plan

The Colorado Air Pollution Control Commission recently promulgated a regulation dealing with fugitive dust. This regulation is discussed in more detail in Section II and the regulation itself appears in Appendix E. A brief summary of the regulation appears below.

1. A general statewide requirement is that no fugitive dust be emitted which exceeds 20 percent visible opacity or which is visible after it leaves the property of the owner of the emission source. Certain activities, such as agriculture, are exempted.

2. Within the Priority I portions of Air Quality Control Regions only (see Figure 24), including a portion of the AQMSA, specific requirements are established for control of dust from:

   a. All new unpaved roads and parking areas with traffic volumes of 165 vehicles/day (vpd) or more.

   b. Existing privately owned roads and parking areas with 165 vpd or more.

   c. Existing publicly owned roads and parking areas with 165 vpd or more, but with controls only to the extent allowed by financial resources.

   d. Land development, construction demolition, and related activities.

3. Specific control requirements, statewide, on open mining activities.

4. Where specific requirements for controls are provided, a requirement that permits be obtained and a requirement that specified types of abatement and preventive measures be identified in the permit and utilized.

Contingency Fugitive Dust Attainment Measures

The contingency attainment strategy for fugitive dust control consists of the controls in the promulgated regulations along with the following additions.

First, the promulgated controls are to be applied to the entire AQMSA and not just the Priority I area. Thus, Gilpin, Clear Creek, Douglas, and Arapahoe will be subject to the controls along with the parts of Larimer, Weld, and Adams Counties which are excluded from the Priority I area.

Second, control measures for dust from sand on paved roads will be promulgated. As estimated in the PEDCo report, this will reduce dust from sanding by 25 percent. A further reduction of dust could be accomplished by promulgating controls for dust from cattle feedlots with the potential for reducing such emissions by 50 percent. However, the minor impact such a strategy would have on the total level of emissions of fugitive dust (less than 0.5 percent) and the resulting insignificant improvement in air quality does not warrant the expense that would be involved in its implementation. Similarly, it would not be politically feasible to expect livestockmen to incur such costs as they are presently supporting the mass transit system through sales taxes.

The impact of this maximum control plan is calculated for the years 1975, 1980 and 1985 based on the calculations given in Appendix J of this report. The growth rates under this level of control are presented in Table 35 for the fugitive dust zones.

This strategy is seen to generally prevent future growth in fugitive dust emissions in spite of increased source activity. Maximum forecasted emissions would be less than 1975 emissions except in a few zones. The worst future emissions increases will be in Clear Creek County where, as noted earlier, substantial construction activity will occur. There, 1985 emissions are estimated to be 11 percent more than 1975 emissions with the promulgated regulations. Without the increased degree of control, emissions would be almost twice as much in several zones.

Table 35. FUGITIVE DUST EMISSIONS GROWTH RATES[a] BY ZONES WITH MAXIMUM FEASIBLE CONTROLS

County	Zone	1975	1975-1980	1975-1985
Adams	1. Cropland	0.95	0.98	0.95
	2. Rangeland	0.91	0.97	0.92
Arapahoe	1. Cropland	0.90	0.89	0.88
	2. Rangeland	0.88	0.87	0.85
	3. Rangeland	0.88	0.87	0.85
Boulder	1. Cropland	0.99	0.99	0.99
	2. Rangeland	0.98	0.97	0.97
	3. Woodland	0.98	0.97	0.97
Clear Creek	Predominantly woodland	0.64	0.93	1.11
Denver	Urban	0.80	0.88	0.96
Douglas	Rangeland and woodland	0.59	0.80	1.02
Gilpin	Predominantly woodland	0.83	0.84	0.84
Jefferson	1. Urban	0.82	0.96	1.04
	2. Rangeland	1.00	1.08	0.95
	3. Woodland	1.00	1.08	0.95
Larimer	1. Cropland	0.98	0.99	0.99
	2. Woodland	0.90	0.94	0.93
	3. Recreation land	0.90	0.94	0.93
Weld	1. Cropland	0.99	0.99	1.00
	2. Rangeland	0.94	0.96	0.97

[a] Tabulated quantities are the ratios of emissions with maximum feasible controls to 1975 emissions with present regulations.

These strategies have the least effect in the counties (Larimer and Weld and, to a lesser degree, Adams and Boulder) where agriculture is the predominant source of fugitive dust. Emissions could be substantially different from these estimates if the amount of agricultural activity should change.

These controls are then used for projecting air quality to 1975, 1980 and 1985 along with the percentage contributions (see Tables 36, 37 and 38). As is seen in these tables, no appreciable improvements in air quality results from this maximum control level. This control measure for fugitive dust still does not provide for the attainment of the primary NAAQS for particulates in Denver County and one site in Weld County by 1975. A further reduction of

$$R = \frac{105 - 75}{105 - 30} \times 100 = 40 \text{ percent}$$

is necessary to meet the primary standard and a reduction of

$$R = \frac{105 - 60}{105 - 30} \times 100 = 60 \text{ percent}$$

is necessary to meet the secondary standard in Denver County.

While sttainment has not resulted, the final goal of maintenance of air quality has been aided as far as increased emissions from the fugitive dust sources sector. This is apparent from Table 35 which shows that most growth rates are less than 1.0 and from Tables 36, 37, and 38, which indicate a decreasing percentage contribution from this sector.

OTHER AREA SOURCE ATTAINMENT MEASURES FOR PARTICULATES

As the maximum practical controls have already been applied to the point and fugitive dust source sectors, the only remaining sector for control is area sources. Data provided on the 1972 NEDS summary sheet for Denver County indicated that 53 percent of the total area source emissions in that county were a direct result of the burning of

Table 36. PERCENTAGE CONTRIBUTION OF PARTICULATE SOURCE SECTORS
FOR MAXIMUM CONTROL CASE FOR FUGITIVE DUST
1975

County	Location	% Contribution			
		Point	Area	Fug.	Adj. AQ[a]
Adams	Westminster	3	61	36	63
	Aurora	7	--	93	43
	Brighton	13	--	87	44
	Adams City	19	36	45	57
Arapahoe	Cherry Creek Dam	--	--	100	36
	Englewood	3	74	23	57
	Littleton	10	54	36	48
Boulder	Boulder	--	87	13	75
	Longmont	2	44	54	75
Clear Creek	Idaho Springs	--	--	100	36
Denver	State Health Dept.	2	37	61	83
	Hull Photo	3	45	52	93
	Julian Street	2	52	41	102
	Sloans Lake	4	44	52	93
	Sewer Plant	9	20	71	76
	Sch. Admin. Bldg. (State)	4	52	44	105
	Gates Building	4	45	51	94
	Sch. Admin. Bldg. (EPA)	4	52	44	105
	2105 Broadway	5	44	51	95
Douglas	Castle Rock	--	--	100	32
Gilpin	Black Hawk	--	--	100	86
Jefferson	Rocky Flats	12	--	88	49
	Golden	11	--	89	38
	Lakewood	5	--	95	26
	Edgewater	5	--	95	66
	Arvada	3	37	60	56
Larimer	La Porte	--	--	100	34
	Fort Collins	2	57	41	68
	Loveland	2	57	41	68
Weld	Greely	3	19	78	83
	Ft. Lufton	2	--	98	73
	Greely	2	18	80	82
	Johnstown	2	--	98	73
	Windsor	2	--	98	72

[a] Adj. AQ is the fitted air quality adjusted for background contributions in $\mu g/m^3$.

Table 37. PERCENTAGE CONTRIBUTION OF PARTICULATE SOURCE SECTORS FOR MAXIMUM CONTROL CASE FOR FUGITIVE DUST 1980

County	Location	% Contribution			
		Point	Area	Fug.	Adj. AQ[a]
Adams	Westminster	3	64	33	67
	Aurora	8	--	92	43
	Brighton	16	--	84	45
	Adams City	20	38	42	59
Arapahoe	Cherry Creek Dam	--	--	100	36
	Englewood	3	76	21	61
	Littleton	10	57	33	49
Boulder	Boulder	--	88	12	80
	Longmont	2	48	50	79
Clear Creek	Idaho Springs	--	--	100	38
Denver	State Health Dept.	1	38	61	90
	Hull Photo	3	46	51	100
	Julian Street	2	52	46	109
	Sloans Lake	3	39	58	109
	Sewer Plant	9	20	71	81
	Sch. Admin. Bldg. (State)	4	52	44	114
	Gates Building	3	46	51	101
	Sch. Admin. Bldg. (EPA)	4	52	44	114
	2105 Broadway	5	45	50	103
Douglas	Castle Rock	--	--	100	33
Gilpin	Black Hawk	--	--	100	87
Jefferson	Rocky Flats	13	--	87	51
	Golden	12	--	88	38
	Lakewood	5	--	95	49
	Edgewater	4	51	45	70
	Arvada	3	37	61	60
Larimer	La Porte	--	--	100	34
	Fort Collins	2	60	38	75
	Loveland	2	60	38	75
Weld	Greely	4	22	74	85
	Ft. Lufton	18	--	82	81
	Greely	2	21	77	85
	Johnstown	2	--	98	73
	Windsor	2	--	98	72

[a] Adj. AQ is the fitted air quality adjusted for background contributions in $\mu g/m^3$.

Table 38. PERCENTAGE CONTRIBUTION OF PARTICULATE SOURCE SECTORS FOR MAXIMUM CONTROL CASE FOR FUGITIVE DUST 1985

County	Location	% Contribution			
		Point	Area	Fug.	Adj. AQ[a]
Adams	Westminster	3	68	29	70
	Aurora	9	--	91	43
	Brighton	18	--	82	45
	Adams City	21	40	39	61
Arapahoe	Cherry Creek Dam	--	--	100	36
	Englewood	4	79	17	64
	Littleton	12	60	28	51
Boulder	Boulder	--	90	10	86
	Longmont	2	51	47	82
Clear Creek	Idaho Springs	--	--	100	38
Denver	State Health Dept.	2	39	59	96
	Hull Photo	3	46	51	107
	Julian Street	2	52	46	115
	Sloans Lake	3	44	53	105
	Sewer Plant	9	21	70	86
	Sch. Admin. Bldg. (State)	4	53	43	122
	Gates Building	4	46	50	108
	Sch. Admin. Bldg. (EPA)	4	53	43	122
	2105 Broadway	5	45	50	109
Douglas	Castle Rock	--	--	100	34
Gilpin	Black Hawk	--	--	100	87
Jefferson	Rocky Flats	17	--	83	49
	Golden	16	--	84	38
	Lakewood	6	--	94	51
	Edgewater	4	51	45	73
	Arvada	3	38	59	64
Larimer	La Porte	--	--	100	34
	Fort Collins	3	65	32	82
	Loveland	3	65	32	82
Weld	Greely	5	25	70	89
	Ft. Lufton	3	--	97	73
	Greely	2	24	74	88
	Johnstown	3	--	97	74
	Windsor	4	--	96	73

[a] Adj. AQ is the fitted air quality adjusted for background contributions in $\mu g/m^3$.

bituminous coal; of this, 96 percent of the emissions were ascribed to industrial area sources. Unfortunately, uncertainties inherent in the determination of the emission levels of the area sources in this Denver County NEDS summary as well as the delineation of area versus point sources preclude the formulation of any control measures based upon this information. As this data tends to indicate the potential for significant reductions in total suspended particulate concentrations, given the control of bituminous coal-dependent sources, this situation should receive additional attention. Prior to this, however, existing data uncertainties must be resolved.

The removal of lead from gasoline has been shown to reduce particulate emissions from the exhaust by 40 to 60 percent. An average reduction of 50 percent would bring about only a 31 percent reduction in the total particulates due to motor vehicles after consideration of tire wear. This could result in another 4 percent reduction due to area sources, or about 2 percent total reduction. However, as more cars become equipped with catalytic mufflers, the impact of such a measure would decrease over time.

Increased effort is still needed in this area to determine whether particulate levels in Denver County can feasibly be expected to attain Federal air quality standards. The solution may lie in a more detailed inventory of fugitive dust and other particulate sources.

SECTION VI

THE PLAN FOR THE MAINTENANCE OF AIR QUALITY

INTRODUCTION

This section presents a strategy for maintaining air quality once it has been attained (in part, with the methods proposed in Section V). The maintenance strategy is based upon a land use and transportation plan already developed for the Denver metropolitan area and used for the air quality projections in this report. The proposed strategy would incorporate the regional plan into a regulatory framework, whereas at present only portions of the plan can be enforced.

The projections of air quality to 1985, presented in Section IV, demonstrate that, under current control requirements, the concentration of total suspended particulates is expected to increase around 20 percent during the time period 1975 to 1985. Hydrocarbons, carbon monoxide and nitrogen oxide concentrations are decreasing during these years as a direct result of the Federal Motor Vehicle Control Program.

The air quality analysis for this report is based, to a large extent, upon the Joint Regional Planning Program (JRPP) for the Denver-Boulder-Longmont metropolitan complex. The JRPP plan was developed jointly by the Denver Regional Council of Governments (DRCOG), the Regional Transportation District (RTD), and the Colorado Division of Highways, and provides for orderly, controlled growth of the region to the year 2000. The JRPP plan assumes the population growth of the area will be at a lower rate than has prevailed recently, and that economic activity can be encouraged to develop in concentrated centers and corridors which will be complementary to public transportation service. The alternative to such a plan is continued sprawl and perhaps more total activity in the Denver area than could be tolerated from the standpoint of air quality.

Based on the information in Section IV, it appears that hydrocarbon and carbon monoxide air quality will be acceptable throughout the maintenance period once the standards are initially met. In the long run, air quality will deteriorate again, unless policies such as that of the JRPP are instituted. Such regional planning is not now essential for the non-metropolitan regions in the AQMSA (at least, not for air quality purposes), but in the future these areas (Larimer, Weld, Gilpin, Clear Creek, and rural portions of the JRPP countries) also will need development planning to prevent degradation of their air quality as a result of continued growth.

The underlying concept of the Air Quality Maintenance Plan (AQMP) is to institutionalize the JRPP plan. In this way, both the growth rate and the distribution of growth which were used in projecting air quality are assured. That is, with the JRPP plan in the SIP the JRPP plan will necessarily be enforced along with the rest of the SIP.

It should be noted that this section does not address the maintenance of the particulate standards. The analysis in Section V indicated that with reasonably available control technology for point and fugitive dust sources, it was not possible to attain even the primary standard in Denver County. As lack of sufficient supporting data does not allow for the implementation of any additional attainment measures and the current and suggested controls are considered the maximum feasible, it is not reasonable to formulate the maintenance of a standard which cannot be achieved. At the most, the AQMP may be expected to slow down the rate of increase of fugitive particulate emissions.

The next part is an overview of the maintenance plan, including the measures and tools for implementation. This is followed by a basically qualitative analysis of the air quality impact of the proposed plan. The actual maintenance measures are then presented in more detail by providing a description of each measure, its legal foundation, and the roles of the agencies assigned to its implementation. The implementation tools are presented next; the legal foundation of each as well as its relation to maintenance implementation is described. The final part of this section deals with the social and economic impacts associated with the maintenance plan implementation.

MAINTENANCE PLAN DESCRIPTION

The specific measures of the maintenance plan are the following.

1. Construction of a rapid transit system.
2. Creation of activity centers throughout the RTD area.
3. Construction of the JRPP highway system.

As a means of fostering the implementation of the above measures, two specific tools are to be utilized. These implementation tools are:

1. Air contaminant emission permits.
2. Land use development permits.

The major pieces of legislation relied upon for this maintenance strategy package are the 1970 Colorado Air Pollution Control Act and the Colorado Land Use Act as amended. These two acts provide a good legal foundation on which to build a viable maintenance mechanism. As specified in more detail in the text, it is recommended that the following specific actions be taken:

1. The State Air Pollution Control Commission will promulgate a regulation incorporating the Regional Transportation District (RTD) transit system into the official state implementation plan. This regulation will include the following elements.
    a. An endorsement of the RTD plan by the Commission.

b. The right of review by the Commission of any changes in the RTD plan which may significantly affect the expected impact of the system.

c. The stipulation that no air quality permit be issued for air pollution sources which might interfere with the construction or operation of the RTD system, the approved highway plan, or land use plans.

d. The requirement that RTD submit within a specified period a plan for reducing the air pollution impact of any system change.

2. The Commission will promulgate a regulation requiring DRCOG to submit an annual report on the progress of the entire JRPP plan.

3. The Commission will promulgate a regulation which requires no new highway construction unless such construction is consistent with the approved highway construction plan. Exceptions will be permitted only if a review shows that the air quality impact is not adverse but is beneficial and consistent with the overall land use plan.

4. An amendment will be enacted to the Colorado Air Pollution Control Act to provide the power needed for absolute review authority for all new sources and indirect sources. The indirect source review authority may be delegated to regional authorities or local authorities with final review by the Air Pollution Control Commission.

   Regulations to be promulgated under this amendment include:

   a. The stipulation that the review criteria for indirect sources include compliance with the JRPP plan.

   b. The coordination of indirect source review with the development controls specified in House Bill 1041, which amends the Land Use Act.

Intergovernmental cooperation is essential for the success of this plan. The agency assigned overall responsibility for the implementation and operation of the maintenance plan is the Air Pollution Control Commission. Enforcement of the plan is to be the responsibility of the Division of Air Pollution Control. In addition, it is necessary to provide for formal information links between the APCC and the Land Use Commission in order to coordinate indirect source review with the land development permit system. This will be accomplished through periodic meetings attended by representatives of both bodies and joint public hearings or permit requests. (An alternative not recommended here but perhaps worthy of consideration would be to make the APCC a formal member of the JRPP, thus facilitating the coordination which is needed.)

Costs of this maintenance strategy package include any additional manpower and monitoring equipment costs. It is felt that the nature of the maintenance plan is such that no significant additional burden is placed upon any of the involved agencies. Thus, a minimal cost is assigned to the air quality maintenance plan.

EXPECTED AIR QUALITY IMPACT OF STRATEGY

As noted earlier, the air quality analysis for this report was based upon data from the approved JRPP plans. It is of particular importance that the travel information used for projecting CO and HC emissions are based upon the JRPP reports and analysis; greater travel activity would entail increased emissions.

Table 40 lists a number of parameters for two cases, the JRPP approved plan and an alternative based upon continuing present trends ("sprawl"). As the table shows, the JRPP plan would not necessarily entail less total socioeconomic activity in the area as a whole (see below) but would concentrate it more (CBD employment would be greater) and would provide much more transit service. At the end of the forecasting period for this report, 1985, the JRPP plan would involve an estimated 1.5 million vehicle-miles of travel per day less than would the alternative, a difference of nearly 6 percent. The difference would actually be greater than that in 1985 because the proposed rapid transit system would be just going into full operation. The system is included in the year 2000 total travel figures, but transit ridership would not be expected to increase to the values estimated by linear interpolation. The effective benefit of the strategy will be greater in certain areas. Because of the high reliance on transit, peak concentrations of traffic and of pollutants

Table 39. EXAMINATION OF ALTERNATIVE GROWTH TRENDS FOR DENVER AREA[a]

	1970	Linear interpolation[b] for 1985		JRPP projections for 2000	
		Present trends	JRPP plan	Present trends	JRPP plan
Region population	1,203,265	1,765,000	1,778,100	2,326,700	2,326,700
Region employment	532,553	837,000	813,800	1,141,500	1,141,560
Denver population	518,405	544,000	592,600	569,600	717,763
Denver employment	307,423	415,200	411,600	523,000	519,957
Denver CBD employment	39,929	43,100	50,000	46,200	55,924
Boulder population	124,742	191,900	191,800	259,000	230,060
Boulder employment	46,368	70,900	77,000	95,400	105,092
Boulder CBD employment	19,692	23,300	28,800	26,900	39,172
Daily auto-driver trips	2,277,775	3,309,000	3,003,900	4,340,297	3,730,091
Daily transit trips	60,105	173,200	439,000	286,218	817,921
Daily transit passenger miles	187,201	1,142,700	2,907,500	2,098,113	5,627,726
Daily vehicle-miles	14,487,200	25,963,500	24,415,400	37,385,849	34,343,676

[a] Data source: Denver Regional Council of Governments.

[b] Data for 1980 and 1990 used for social-economic parameters for JRPP plan (only).

will be greatly reduced. No data is available for quantitative estimates of this effect. The comparison in Table 40 is based upon two cases with the same total population but different distributions of population and different transportation systems. Without the controls proposed here, the total socioeconomic activity and associated travel volumes could be substantially greater than assumed in Table 40. Consider the following:

> The Denver Metropolitan Area, since the 1970 Census, has been growing at an unprecedented rate. The overall increase in the 1960's was at a rate of slightly less than 3.0 percent on an average yearly basis, while in the three subsequent years, the annual growth rate has been estimated at 3.3 percent in 1970, 4.4 percent in 1971 and 5.3 percent during 1972 . . .
>
> . . .Long-term forecasts show the potential of a tripling in size of the metropolitan area in less than thirty years . . . Without stretching the imagination, a 'reasonable' forecast of population can range anywhere between 2.2 and 3.9 million people for the Denver Metropolitan Area by the year 2000. The Joint Regional Planning Program has adopted a conservative estimate of about 2,350,000 people as a desirable level for the year 2000 . . .[1]

If population were to grow to 3.9 million in 2000 instead of to 2.35 million, as assumed in the JRPP plan, and if travel should increase proportionally, automotive emissions would be 66 percent greater than would be forecasted using the JRPP projected population, resulting in poorer air quality.

MAINTENANCE MEASURES

Construction of a Rapid Transit System

The Regional Transportation District (RTD) is a transportation authority for the Denver metropolitan area created by Chapter 89, Article 20 of the Colorado Revised Statutes. RTD began to plan a mass transportation system in 1970. At the present time the RTD consists of Boulder, Jefferson, and Douglas Counties, the City and County of Denver, and the western portions of Adams and Arapahoe Counties. The public transportation plan developed by RTD is shown in Figure 41. It consists of 100 miles of two-way guideways with 58 stations interconnected by automatically controlled, demand-activated, 12-passenger vehicles.

In September, 1973 the voters in the Regional Transportation District approved a bond issue as part of the financing for the public transportation system. In March 1974 RTD selected a systems engineering team to develop detailed plans for the system. Alternatives, exact routes, environmental impacts, and detailed design are all still under study. It is expected that construction of the Personal Rapid Transit (PRT) system will take 10 years, so that the complete system will not be available until 1983 or 1984, near the end of the period with which this maintenance plan is concerned. In the meantime, however, extensive bus service increases are also planned and sections of the rapid transit system will be utilized as they are completed. The first phase of the bus service increase, the Early Action Program, will involve acquisition of six existing bus companies and increasing the amount of bus service by 61 percent by 1975.[2]

No additional legislation is necessary in order to carry out the RTD program for a rapid transit system and increased bus service. RTD has adequate taxation powers and bonding authority to construct the system and operate it. What is needed is for the RTD plan to become part of the official State Implementation Plan (SIP). The Colorado Air Pollution Control Commission appears to have adequate authority under the Colorado enabling legislation for state air pollution control (Chapter 66, Article 31) to allow the Commission to adopt the RTD plan (and other elements of the Joint Regional Planning Program) as an official part of the SIP. If this proves not to be the case the necessary legislation should be enacted. It is recommended that the Commission adopt regulations incorporating the RTD rapid transit system into the official SIP. The Early

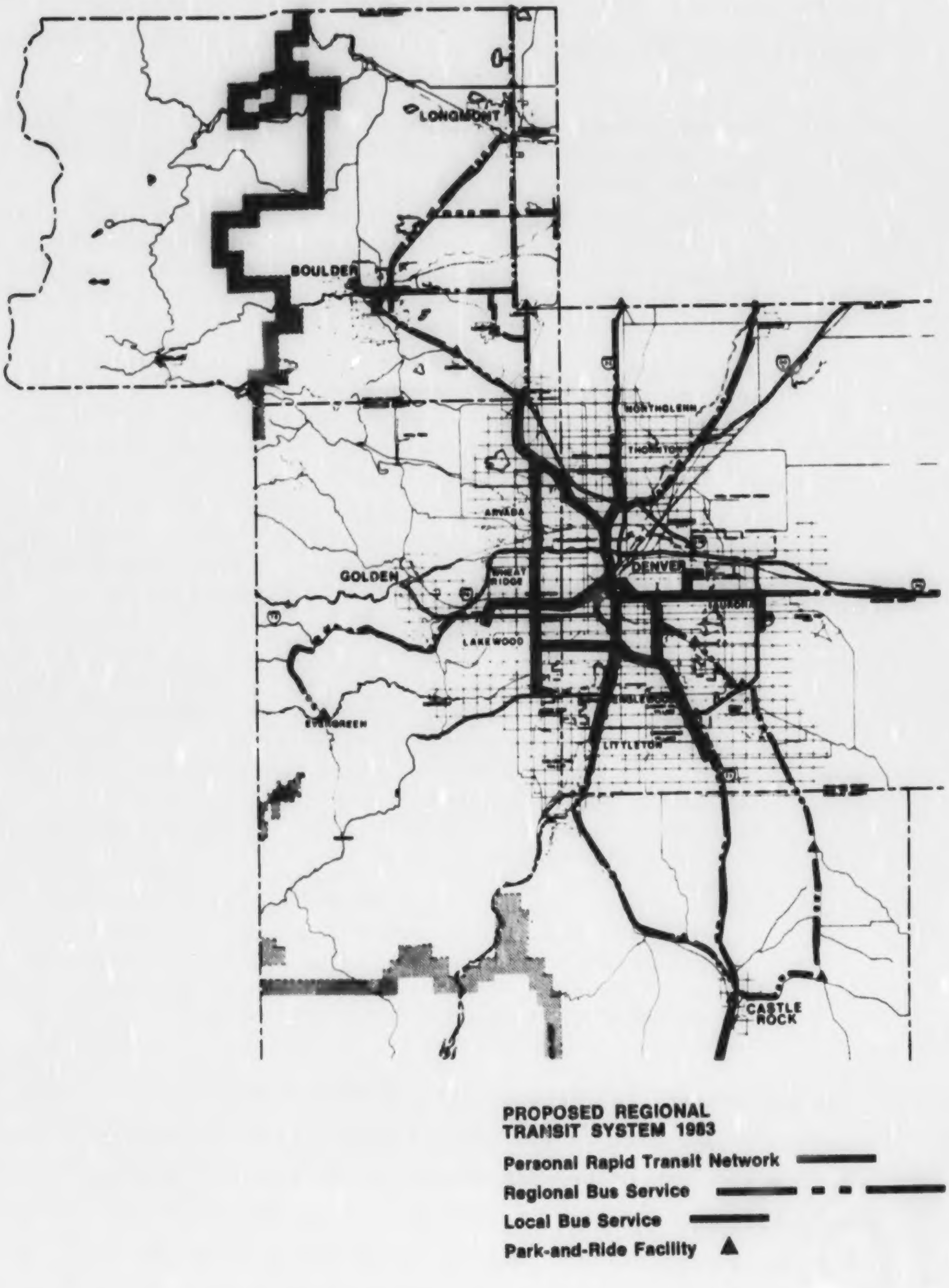
LONGMONT
BOULDER
NORTHGLENN
THORNTON
ARVADA
GOLDEN
WHEAT RIDGE
DENVER
AURORA
LAKEWOOD
EVERGREEN
ENGLEWOOD
LITTLETON
CASTLE ROCK
PROPOSED REGIONAL
TRANSIT SYSTEM 1983
Personal Rapid Transit Network
Regional Bus Service
Local Bus Service
Park-and-Ride Facility

Figure 41. Joint Regional Planning Program transit system

Action bus portion of the RTD system is in the Colorado Transportation Control Plan. The regulations will include the following elements:

1. An endorsement by the Commission of the RTD rapid transit plan as an element of a coordinated community development plan consistent with air quality goals.
2. A requirement that RTD submit for the Commission's review any change in the plan which would significantly affect the expected impact of the system on the amount or location of automobile travel, or significantly affect air quality in the metropolitan area.
3. A requirement that no permit be issued for air pollution sources which would be located in a manner which could interfere with construction or operation of the RTD system, or would interfere with the associated approved highway or land use plans.
4. A requirement that RTD develop, within a specified period, a recommendation for reducing the air pollution impact of any system change (from 2 or 3 above) which had been determined by RTD or the Commission to affect air quality maintenance.
5. A related regulation will require the Joint Regional Planning Program (RTD, DRCOG, and the Colorado Division of Highways) to report annually to the Commission on the progress of the entire JRPP planning process. Each annual report should identify the estimated impact on air quality of each project completed during the past year and the expected effect of all major plans or plan changes adopted during the past year. (This could also be accomplished by requiring APCC approval of certain key reports issued as part of the regional transportation planning process, such as the annual Work Program and Unified Regional Transportation Work Program, the Annual Report, or the Operations Plan. This also could be combined with the review required by 23 U.S.C. 109 (j) and described below.)

The recommended regulations will provide a legally enforceable basis for using the RTD plan in the SIP and will provide a framework for incorporating air quality considerations in the detailed planning process and in subsequent changes. Furthermore it will provide an important tool for new source review. One of the criteria in 40 CFR 51.18 for review of new sources is whether the source would violate an adopted control strategy in the SIP; a new source could not be approved under the proposed regulations if it would be inconsistent with the JRPP plans for the transit system (or associated highways and land use). Also, the regulations provide for monitoring the long process of implementing the plans. These regulations will be enacted within one year, as part of preparation of the maintenance plan required by June 1975.

Implicit in the use of the JRPP plan as a maintenance strategy is the need for coordination between the agencies responsible for the JRPP plan (the Colorado Division of Highways, the Denver Regional Council of Governments and the Regional Transportation District, and the local government members of RTD and DRCOG) and the Colorado Air Pollution Control Commission and Division. DRCOG and RTD will develop explicit methods for incorporation of air quality considerations into their planning process, in a quantitative way. This is to be done internally or arrangements will be made for technical assistance from the Air Pollution Control Division or from DRCOG.

To a large extent, existing Federal regulations applicable to planning and construction of transportation systems already require extensive community and agency cooperation and involvement, and require analysis of air quality (as well as other environmental effects), so existing intergovernmental frameworks and processes should suffice.

The procedures for that planning, and how they can be related to air quality maintenance plans, have been discussed at length in recent reports.[3,4,5] The requirements for interagency cooperation in transportation planning are briefly summarized as follows.

1. Federal law (23 U.S.C. 134) requires state governors to designate areawide transportation planning agencies for all urban areas with 50,000 people or more, which in turn are required to conduct the "continuing, comprehensive, cooperative" (3-C) planning process for multi-modal transportation systems. Regulations specify that this planning must include a formal procedure for responding to the needs and desires of local governments, including public hearings. Numerous specific reports (some referred to above) are required to be issued.

2. The Urban Mass Transportation Assistance Act of 1970 (and other legislation) requires that all applications for Federal funds for planning or construction of transportation facilities be submitted to the areawide planning agency designated as responsible for metropolitan and regional planning (the so-called A-95 review process).
3. The National Environmental Policy Act requires preparation of environmental impact statements for all major federal actions significantly affecting the environment (such as grants for transportation facilities). Guidelines for preparing such statements require extensive opportunities for public and government involvement and comment.
4. Federal law (23 U.S.C. 109 (j)) and related regulations require that each 3-C planning agency annually review the transportation plan to insure it is consistent with the SIP.

In the Denver area, the designated areawide 3-C planning agency is the Joint Regional Planning Program, jointly operated by the Division of Highways, the Denver Regional Council of Governments and the Regional Transportation District. DRCOG is also the designated agency for A-95 review and for coordinating the review of environmental impact statements. Since RTD and DRCOG are statutorily composed of representatives from the county governments in their respective planning areas, intergovernmental cooperation mechanisms are inherent. These relationships could be modified by formally establishing criteria for incorporating air quality considerations in planning, such as through additional APCC regulations.

Creation of Activity Centers

A major feature of the JRPP land use plan is development of 13 activity centers. These centers are described as aggregations of urban activity large enough to be primary generators of large internal activity. They are expected to be terminal locations for the rapid transit system. Their creation will serve a twofold purpose. First, it will tend to lessen the air pollution now centered around Denver by redirecting some of the future growth. Secondly, to the extent that large numbers of individuals are expected to live, work, and shop in the activity centers, VMT will be reduced.

The activity centers recommended by the JRPP are listed below.

Boulder	University of Colorado/Crossroads Shopping Area/CBD
Northglenn	Northglenn Shopping Area/Western Electric Front Range Denver Area
Arvada	Old CBD/Tri-Center Area
Federal Center	Federal Center/Community College/Westland Areas
Villa	Villa Italia Shopping Center
Alameda	Alameda/I-225 Area
Denver CBD	CBD/Auraria/Skyline Area
Medical Center	University of Colorado Medical Center/Colorado-Colfax Area
Cherry Creek	Cherry Creek Shopping and Residential Area
South Colorado	Colorado Boulevard/I-25 Area/University of Denver/University Hills
Englewood	Englewood CBD/Cinderella City Shopping Center
Technological Center	Area of Denver Technological Center/Greenwood Plaza
Littleton	Littleton CBD Area

No additional legislation is needed to create activity centers. Instead, their evolution is dependent upon the construction of the rapid transit system as well as the JRPP highway plan. Air contaminant emission permit review will also serve as a prime tool in activity center creation.

Construction of the JRPP Highway System

The Joint Regional Planning Program (JRPP) for the Denver metropolitan area includes an approved highway plan intended to coordinate with and complement the RTD public transportation plan. This plan is shown in

Figure 42. The limited access and principal arterial portions of this plan have been approved, and work in underway to develop a construction program. This plan was the basis for the travel estimates used in this study for computing future air quality.

No new legislation is required for completion of the highway program, except for construction appropriations. Regulations will be adopted by the Air Pollution Control Commission to require that no highways be built unless they are consistent with this approved plan, exceptions being permitted after a specific review for the air quality impact of the change. (Present practice is for highway construction to be reviewed by the Air Pollution Control Division for its effect.) The intent of this regulation is not to encourage highway construction but rather to insure that no major highway links beyond the JRPP plan are built without review for air quality. This regulation will complement indirect source review in that it will apply to any link on the JRPP plan even if such a link does not require indirect source analysis (only major highways are subject to indirect source review under EPA regulations). (DRCOG is at present planning to conduct an analysis of the air quality impact of the JRPP system.)

In this connection it should be noted that the air quality analysis performed for this report is a macroscale analysis and not sufficiently detailed to demonstrate whether particular highway links would or would not satisfy the requirements for such indirect sources. It is recommended that a detailed areawide highway system review be undertaken separately, before the Commission endorses the JRPP plan. (The DRCOG review may suffice for this purpose.) Both this review and the proposed regulations will be completed by June, 1975.

As with the RTD system, this measure will involve cooperative arrangements among the JRPP members and the Air Pollution Control agencies. EPA will be more involved in this case, because of the explicit requirement in both EPA and Federal Highway Administration regulations for

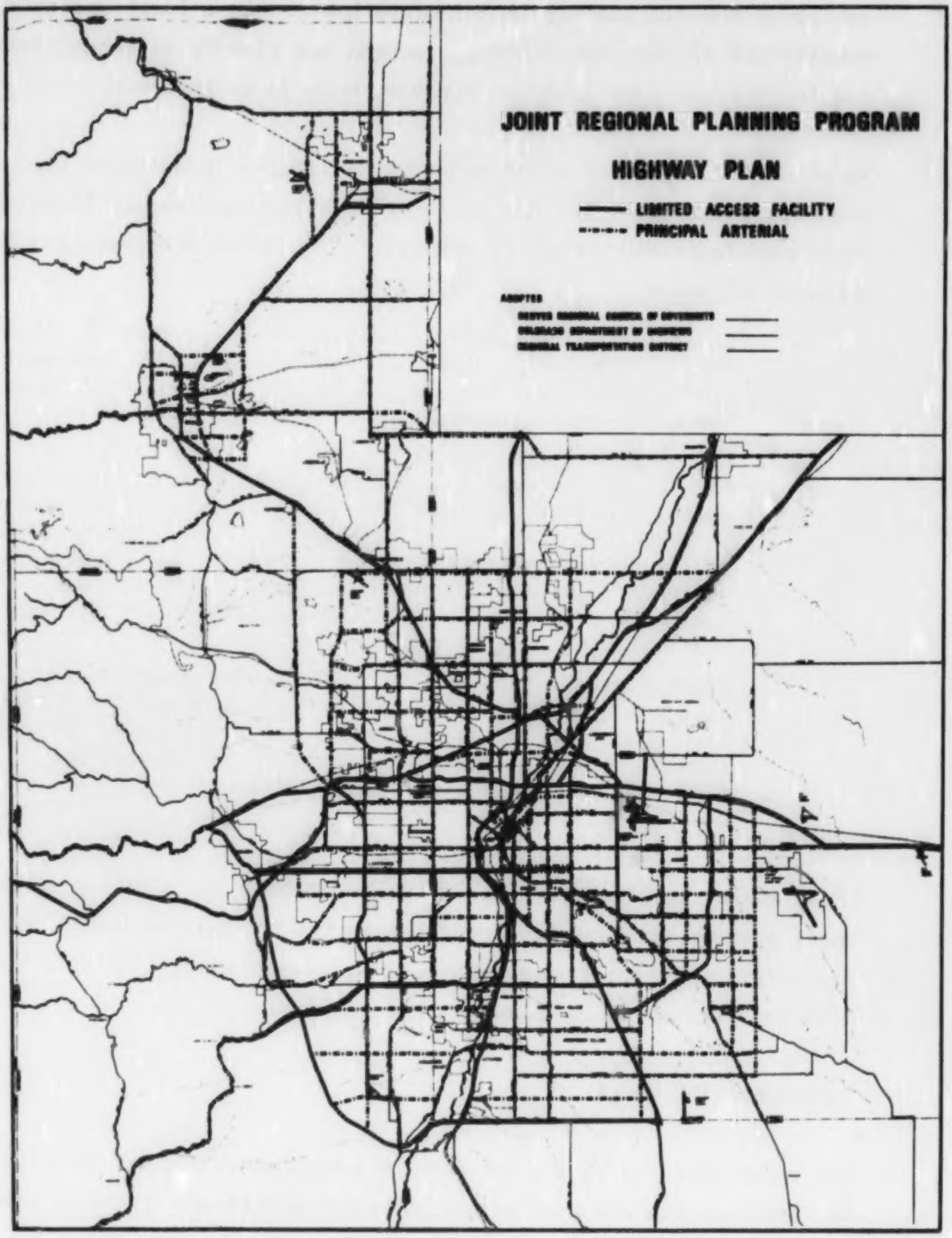
JOINT REGIONAL PLANNING PROGRAM
HIGHWAY PLAN
LIMITED ACCESS FACILITY
PRINCIPAL ARTERIAL
ADOPTED
DENVER REGIONAL COUNCIL OF GOVERNMENTS
COLORADO DEPARTMENT OF HIGHWAYS
REGIONAL TRANSPORTATION DISTRICT

Figure 42. Joint Regional Planning Program highway plan

review of the air quality impact of highways. To a large extent the cooperative efforts for highway planning are already institutionalized and involve the very agencies proposed here to be involved.

As with other types of transportation facilities, procedures for planning highways and their relationship to air quality maintenance planning have been described in recent reports.[3,4,5] These processes can be summarized as follows.

1. Federal-aid highways must be planned as part of the multimodal 3-C process, described earlier for other transportation systems, and are subject to the environmental impact and A-95 review processes.
2. State highway agencies must prepare "Action Plans" to "assure that adequate consideration is given to possible social, economic, and environmental effects of proposed highway projects . . ." These Action Plans must provide for "involvement of other Federal, state, and local agencies . . . and interested groups . . ." in both Action Plan preparation and highway planning.[6] Colorado has completed such an Action Plan.
3. Federal regulations (23 CFR 770) require that highway agencies coordinate with the 3-C agencies and air pollution control agencies to establish a process for continuing review of the consistency of the transportation plan and the state implementation plan for air quality.[7]

Thus, these requirements already involve DRCOG, the Division of Highways, local governments, and the Federal agencies in an established framework for intergovernmental cooperation in highway planning. Little new effort is expected to be necessary for this measure.

IMPLEMENTATION TOOLS

The two primary tools for ensuring the implementation of the maintenance measures are the air contaminant emission permit and the land development permit systems. These two items are discussed below.

Air Contaminant Emission Permit

EPA regulations (40 CFR 51.18) require that each state shall have legally enforceable procedures to determine whether the construction or modification of a facility will interfere with the attainment or maintenance of a national standard either directly because of emissions from it, or indirectly, due to emissions resulting from mobile source activities associated with it. Such procedures must include means by which an application for approval to construct or modify will be denied if it would result in the interference with the attainment or maintenance of the standard.

The Colorado Air Pollution Control Act of 1970, as amended, prohibits the construction or operation of new direct or indirect sources of air pollution without first filing an "air contaminant emission notice" and then obtaining a valid permit therefor from the Air Pollution Control Commission. However, no permit is required for new indirect sources until regulations regarding the permits for such sources are promulgated by the Commission; to date, no such regulations have been promulgated. The permits are to be denied if the applicable emission standards are not met or if it is determined to interfere with the attainment or maintenance of the federal ambient air standards unless the proposed project or activity utilizes the best practical (reasonably available control) technology. The law (66-31-15) also provides a variance process which allows variances to be granted if compliance with emission control regulations would create an "unreasonable economic burden." Note, however, that under either EPA or Colorado regulations only sources over a certain size require permits.

This appears not to provide the authority required by 40 CFR 51.11 because permits can be granted through the Colorado variance procedure even if the requirements of Federal regulations are not met. At present Colorado has not promulgated regulations specifically for indirect source review. In the absence of Colorado regulations, EPA regulations published in the Federal Register on 25 February 1974 and amended on 9 July 1974 make review of new or modified indirect sources in Colorado (and other states) subject to EPA control under 40 CFR 52.22 (see Section II). The Colorado Air Pollution Control Commission did, on April 26, 1973, adopt a policy related to indirect sources. In that policy statement the Commission requested "that the Colorado Legislature recognize the importance of and pass legislation mandating the joint use of Land Use and Transportation planning as necessary tools for the attainment and maintenance of publicly acceptable levels of air quality by granting sufficient powers to appropriate agencies for this purpose."

A policy will be formulated and adopted which incorporates the JRPP land use and transportation plans in the air contaminant emission permit review process. The approved JRPP plan will be a criterion for judging whether new sources are appropriate. This will complement the other recommended measures involving the JRPP plan in maintenance of air quality, and provide a regulatory tool for fostering orderly development in accordance with the JRPP plan. In essence, new sources could not be built if they were not consistent with the JRPP plan, as for example in the case where the new shopping center would violate the growth center concept.

Several legal actions are required to implement this recommendation. First, the Colorado legislature needs to enact a change in the Air Pollution Control Act to provide the absolute authority required by Federal regulations. Also, the law should provide for delegation of the indirect source review authority to regional or local authorities. Next, the Commission should enact the detailed regulations necessary to control new sources. These regulations will include the following elements:

1. Establish or reiterate (as necessary) that the criteria for review of air contaminant emission permit requests in the JRPP area include the question of compliance with the JRPP plan.

2. Provide for coordination of indirect source review with the provisions under Colorado House Bill 1041 for control of development around key facilities such as highways.

All these regulations and legislative actions should be completed by June 1975.

The JRPP planning process is already founded on a well-established cooperative basis. This proposal will add to the use of the established coordination functions and strengthen DRCOG's role in ensuring the coordinated, orderly development of the Denver metropolitan area. Added cooperation will be required between DRCOG and the Colorado Air Pollution Control agencies, as is required for the other measures involving the JRPP plan.

Land Development Permits

House Bill 1041 amended the state Land Use Act by providing for the identification, designation, and administration of areas and activities of state interest. While it is primarily a local government responsibility to designate and administer areas of state interest, the Colorado Land Use Commission is given the authority to review such designations and administration guidelines. Furthermore, the Land Use Commission may submit a formal request to a local government to take action with regard to a specific matter which the Commission considers to be of state interest.

Among the enumerated state area interests are interchanges involving arterial highways as well as rapid or mass transit terminals, stations, and fixed guideways. Thus, the JRPP plan and hence the maintenance plan includes areas of state interest. As such, development permits will be required in these areas before such development can take place. To this extent, H.B. 1041 can serve to control growth in accordance with the JRPP plan. These development permits are needed to supplement air contaminant emission permits in part because small sources (such as minor indirect sources) require no emission permits.

SOCIAL AND ECONOMIC IMPACTS

As has been mentioned, the components of the JRPP plan which were selected as maintenance measures include the transit plan, the highway plan, and the concept of activity centers. Since the transit plan is by far the most significant of these in terms of impact, the following discussion will focus on it, with analysis of the highway and activity centers relegated to secondary consideration.

The discussion is organized as follows. First the impacts on the social system are analyzed. These impacts include not only objective considerations, but certain subjective considerations as well. Economic impacts are discussed next. The effects of the system on employment, income, and business establishments are included under this category as are the effect on the system on the state budget and on energy consumption. This discussion is by no means meant to be a detailed analysis of the proposed transportation plan. Instead, it is only meant to display the possible areas of resistance to the JRPP plan implementation.

There are two major social impact areas. On the positive side is the increased mobility which such a transportation system would bring about. The main negative area of impact is the removal of houses and relocation of the residents caused by guideway and station construction.

Mobility is perhaps the most obvious social area affected by a transportation system. Preliminary studies conducted for the RTD have indicated a widespread increase in mobility for the population as a whole. For upper and middle income families, the increased mobility is in the form of having an alternative to the automobile. Low income families, which comprise the bulk of transit-dependent individuals along with the physically handicapped and school-age youth, stand to benefit the most from a mass transit system. While there do exist certain gaps in service to some transit-dependent areas, the group as a whole should be well served. For example, the elderly and physically handicapped will have much better access to hospitals and clinics once the complete system has been constructed. One drawback does exist, however. As planned, several transit-dependent areas have to rely on feeder bus service to the rapid transit station. This involves both a time and pecuniary penalty to these individuals. This penalty is offset to some extent by increased job mobility, which is discussed later.

Relocation of individuals occurs when rapid transit corridors go through residential areas. In general, the approved rapid transit routes do not bisect any identifiable neighborhood units. There are some areas, however, where displacement of existing housing occurs. This must be considered a negative impact.

A final social impact is subjective in nature and has to do with the reaction of residents of affected neighborhoods to a rapid transit system and the proposed highway system. In general there is some reaction by certain neighborhoods to either additional highways or a rapid transit network going through their area. Obviously not all neighborhoods can be satisfied but the plan appears to be flexible enough to mitigate at least a portion of these negative feelings through public participation meetings.

The economic impacts of the JRPP plan are impacts on employment, income, and business establishments. Employment in the area is affected in two ways. First, the construction and later the operation of a rapid transit system will create additional employment opportunities. One study estimated that 8,000-10,000 jobs would be provided in the construction industry over the 25-year construction period. Secondly, to the extent the transit plan increases accessibility, labor force mobility will be increased. This in particular may prove to be a major benefit to low-income groups since their geographic range of employment opportunities will be increased.

Table 40 gives the three annual budgets for "typical" four person families. The impact on household income arises from two areas. The first area has to do with the method of financing. The method adopted by the Colorado legislature revolves around a 0.5 precent sales tax. As shown by the table below, at best this is a proportional tax, and to a small extent is income regressive in nature. The point is that as a percentage of total income, lower income groups will be contributing as much to the transportation financing as the intermediate and upper income groups.

This is compounded by the fact that in several low income areas there is to be no rapid transit service, but instead feeder bus service.

IMPACT OF TRANSPORTATION PLAN SALES TAX

Four-family budget level	Annual income	Taxable income[a]	0.5% sales tax	Rebate[b]	Net tax	Net tax. income
Lower	$ 7,976	$4,582	$22.91	$1.17	$21.74	0.27%
Intermediate	12,107	6,563	32.82	1.17	31.65	0.26%
Higher	17,422	9,127	45.64	1.17	44.47	0.26%

[a] Taxable income is composed of 100 percent of food, clothing, personal care, and other family consumption as well as 40 percent of transportation and housing expenditures.

[b] Present rebate is $7 for the 30 percent tax, therefore, the RTD rebate would be $\frac{0.5}{3.0} = \frac{1}{6} \times \$7 = \$1.17$.

A second impact of the transportation system on household income has to do with transportation costs themselves. Transportation cost reductions are expected to be greatest for lower income families who work in the industrial and commercial areas served by the rapid transit/bus system.

Table 40. ANNUAL BUDGETS FOR A FOUR-PERSON FAMILY - DENVER METROPOLITAN AREA

	Autumn 1973					
	Lower		Intermediate		Higher	
	Absolute	Percentage	Absolute	Percentage	Absolute	Percentage
Total budget	$7,976	100	$12,107	100	$17,422	100
Family consumption						
Food	2,363	29	2,996	25	3,883	22
Housing	1,493	19	2,612	22	3,917	22
Transportation	536	7	1,000	8	1,226	7
Clothing	834	10	1,151	10	1,617	9
Personal care	196	2	264	2	378	2
Medical care	630	8	636	5	662	4
Other	378	5	707	6	1,192	7
Total consumption	$6,430	80	$ 9,366	78	$12,875	73
Other items	381	5	597	5	996	6
Social security and disability	468	6	632	5	632	4
Personal income tax	697	9	1,512	12	2,919	17

Source: U.S. Bureau of Labor Statistics, July 10, 1974.

The actual impact will be dependent upon the finalized rate structure (projected to be an average of $0.35 per trip) as well as the final route alignment.

The third economic impact area has to do with the effect of the transportation system on the commercial business establishment. Surveys conducted by the RTD have shown that only one-half of the respondents felt that the rapid transit system would affect them. However, the overall effect of the mass transit/bus system will be to concentrate shopping activities in areas reserved for the rapid transit system. This may force some business establishments to relocate to these reserved areas or suffer possible loss in revenues.

In conclusion, the overall socioeconomic impact of the RTD transportation plan appears to be generally favorable.

REFERENCES

1. Joint Regional Planning Program, Regional Development Policy. A Growth Policy Strategy for the Regional Study Area. Technical Memorandum 1-1/001, December 1973.

2. Regional Transportation District. Early Action Program. (Undated.)

3. Alan M. Voorhees and Associates, Inc. Guidelines for the Review of Urban Transportation Plans and Programs Pursuant to 23 CFR 770.204. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, Draft, April 26, 1974.

4. U.S. Environmental Protection Agency, Office of Air and Waste Management, Office of Air Quality Planning and Standards. Guidelines for Air Quality Maintenance Planning and Analysis. Vol. 4: Land Use and Transportation Considerations. Research Triangle Park, North Carolina, June 1974.

5. U.S. Environmental Protection Agency, Office of Air and Waste Management, Office of Air Quality Planning and Standards. Guidelines for Air Quality Maintenance Planning and Analysis. Vol. 2: Plan Preparation. Research Triangle Park, North Carolina, June 1974.

APPENDIX A

ECONOMIC DATA FOR THE DENVER AQMSA BY COUNTY

This appendix contains general economic data for the Denver Air Quality Maintenance Study Area, compiled by county. This data was originally presented in "Policy Analysis for Rural Development and Growth Management in Colorado", a report prepared for the Colorado Rural Development Commission by the Denver Research Institute, University of Denver.

EXPLANATION OF COUNTY DATA SHEETS

1. The 1970 population per the U.S. Census of Population.

1a. The percent change in population 1950-1960 and 1960-1970.

2. Relative income, or this county's median family income as a percent of median family income for Colorado, per Census of Population.

3. The percent of families with income below the poverty level per the 1970 Census of Population.

4. Labor participation rate, or percent of population employed, per Census of population.

5. Total employment of residents of the county per Census of Population.

6. Unemployment as a percent of total civilian labor force per Census of Population.

7. Per capita tax income to the State of Colorado is represented by the county sum of state income tax liability plus state sales tax collections divided by the population.

8. Per capita welfare costs to the state are the state's contribution of state funds (only) divided by population.

9. Per capita education costs are total payments to school districts of state funds divided by population.

10. This figure shows the surplus (S) or deficit (D) of state taxes collected compared with education and welfare expenditures.

11. The percentage of employed residents of the county in each of 10 sectors of the economy. (The parenthetical numbers are absolute numbers, in addition to the percentages.)

12. This is a subjective statement of the first order determinants of change in population and economic activity. Agricultural employment almost invariably shows substantial decreases over the 1950-1970 period because of greater economic efficiency in agricultural production. This increased productivity was such that, given a constant production level between 1950 and 1970:

    employment in raising meat animals would have halved;
    employment in raising feed grains would decrease to one fifth;
    employment in raising hay would have halved;
    employment in raising food grains would decrease to one third;

    according to Changes in Farm Production and Efficiency, USDA.

    In the same period, coal mining employment would similarly have dropped to about a third of its original level, with constant output.

    These increases in productivity have greatly affected employment and population in Colorado farming, ranching and coal mining counties.

ADAMS COUNTY

County Seat: Brighton; population: 8,309

1. 1970 population: 185,789

1a. Percent change 1960-1970: 54.4
Percent change 1950-1960: 199.0

2. Median income as percent of state average: 1970: 108.9
1960: 110.0
1950: 102.2

3. Percent families below poverty level: 18.1

4. Percent of population employed: 1970: 37.3
1960: 33.8
1950: 31.2

5. Actual employment: 1970: 69,284
1960: 40,626
1950: 12,571

6. Percent of labor force unemployed: 1970: 4.0
1960: 3.5
1950: 3.9

7. Tax income to state: $101.15

8. Welfare costs to state: $9.03

9. Education costs to state: $71.19

10. Per capita surplus or deficit: $20.93 S

11. Percent employed by industry:

	1970	1960	1950
agriculture	2.4	4.3	20.5
mining	0.6	0.6	0.2
construction	7.5	9.5	10.5
manufacturing	18.9 (13138)	21.2	15.0 (1886)
transportation	11.0	12.0	10.4
trade	25.2	21.7	18.3
services, including lodging and finance	13.5	13.0	10.0
health services and other professions	8.0	4.9	5.6
education	6.3	4.4	2.8
public administration	2.9	6.2	4.8

12. Agricultural employment declined somewhat, but manufacturing employees increased sevenfold and bedroom communities thrived as the Denver metropolitan area grew.

ARAPAHOE COUNTY

County Seat: Littleton; population: 26,318

1. 1970 population: 162,142

1a. Percent change 1960-1970: 42.9
Percent change 1950-1960: 117.6

2. Median income as percent of state average: 1970: 126.2
1960: 123.5
1950: 107.9

3. Percent families below poverty level: 4.6

4. Percent of population employed: 1970: 39.2
1960: 35.4
1950: 35.0

5. Actual employment: 1970: 63,500
1960: 40,168
1950: 18,238

6. Percent of labor force unemployed: 1970: 2.8
1960: 3.5
1950: 3.2

7. Tax income to state: $151.74

8. Welfare costs to state: $5.35

9. Education costs to state: $73.95

10. Per capita surplus or deficit: $72.54 S

11. Percent employed by industry:

	1970	1960	1950
agriculture	1.1	2.3	7.2
mining	1.6	1.1	0.3
construction	6.4	8.2	12.0
transportation	7.3	7.7	9.9
manufacturing	17.7	25.5	17.7
trade	23.5	19.2	21.9
services, including lodging and finance	15.8	14.9	13.4
health services and other professions	11.7	7.8	5.8
education	8.5	5.0	3.7
public administration	5.8	5.8	6.0

12. Typical of Denver metropolitan area growth. Manufacturing grew steeply in the 1950's (Martin - Denver) and eased. Trades and services have continually grown with suburbanization. Relative income is high.

BOULDER COUNTY

County Seat: Boulder; population: 66,870

1. 1970 population: 131,889

1a. Percent change 1960-1970: 77.6
Percent change 1950-1960: 53.7

2. Median income as percent of state average: 1970: 117.2
1960: 105.8
1950: 94.2

3. Percent families below poverty level: 5.6

4. Percent of population employed: 1970: 39.8
1960: 36.9
1950: 33.5

5. Actual employment: 1970: 53,482
1960: 27,382
1950: 16,160

6. Percent of labor force unemployed: 1970: 4.4
1960: 3.1
1950: 6.7

7. Tax income to state: $126.59

8. Welfare costs to state: $7.63

9. Education costs to state: $48.72

10. Per capita surplus or deficit: $70.24 S

11. Percent employed by industry:

	1970	1960	1950
agriculture	1.8	5.3	11.4
mining	0.6	1.1	3.8
construction	5.5	8.3	3.3
manufacturing	21.0	13.2	9.3
transportation	5.0	5.2	7.7
trade	18.0	19.2	6.2
services, including lodging and finance	12.9	15.7	20.4
health services and other professions	10.5	7.9	16.5
education	18.3	14.8	5.6
public administration	5.8	6.6	14.8

12. Manufacturing employees living in Boulder County increased ninefold, 1950-1970. Educational employment boomed as the University grew. Boulder also became more of a bedroom community for the Denver metro area. Relative income went up substantially.

CLEAR CREEK COUNTY

County Seat: Georgetown: population: 542

1. 1970 population: 4,819

1a. Percent change 1960-1970: 72.5
Percent change 1950-1960: -15.1

2. Median income as percent of state average: 1970: 101.4
1960: 88.5
1950: 95.3

3. Percent families below poverty level: 5.7

4. Percent of population employed: 1970: 42.2
1960: 39.0
1950: 32.6

5. Actual employment: 1970: 1,987
1960: 1,088
1950: 1,236

6. Percent of labor force unemployed: 1970: 4.1
1960: 4.5
1950: 4.2

7. Tax income to state: $109.77

8. Welfare costs to state: $13.00

9. Education costs to state: $30.28

10. Per capita surplus or deficit: $66.49 S

11. Percent employed by industry:

	1970	1960	1950
agriculture	1.0	1.6	3.6
mining	13.4	5.5	9.3
construction	18.1	15.3	20.7
manufacturing	6.7	7.3	4.7
transportation	4.5	9.5	7.2
trade	20.4	25.1	24.3
services, including lodging and finance	17.3	20.0	16.9
health services and other professions	5.0	2.7	3.4
education	5.8	6.3	4.5
public administration	7.3	5.4	3.9

12. Mining, construction and tourism all grew between 1960 and 1970 to double the county's population. Natural resources and proximity to Denver accounted for this growth.

DENVER COUNTY

County Seat: Denver

1. 1970 population: 514,678

1a. Percent change 1960-1970: +4.2
Percent change 1950-1960: +18.8

2. Median income as percent of state average: 1970: 101.0
1960: 110.1
1950: 115.8

3. Percent families below poverty level: 9.4

4. Percent of population employed: 1970: 41.3
1960: 39.8
1950: 40.2

5. Actual employment: 1970: 212,695
1960: 196,383
1950: 167,218

6. Percent of labor force unemployed: 1970: 4.1
1960: 3.7
1950: 4.1

7. Tax income to state: $165.65

8. Welfare costs to state: $17.51

9. Education costs to state: $26.37

10. Per capita surplus or deficit: $121.77 S

11. Percent employed by industry:

	1970	1960	1950
agriculture	0.7	0.8	0.9
mining	1.0	0.8	0.3
construction	5.1	5.3	7.0
manufacturing	14.9	18.0	16.7
transportation	7.9	8.3	11.7
trade	23.0	21.7	25.3
services, including lodging and finance	18.0	16.8	17.5

11. (continued)	1970	1960	1950
health services and other professions	12.4	9.4	8.0
education	8.0	5.1	3.9
public administration	6.7	7.7	7.1

12. Growth has been physically constrained by contiguous incorporated suburbs. There has been substantial white out-migration to suburbs, and in-migration by blacks and browns. Relative income dropped, 1950-1970. However, Denver is the core of the fast growing Denver Metropolitan Area, a beneficiary of the national trend toward urbanization and of the area's attracting power for in-migration.

DOUGLAS COUNTY

County Seat: Castle Rock; population: 1,531

1. 1970 population: 8,407

1a. Percent change 1960-1970: +74.6
Percent change 1950-1960: +37.3

2. Median income as percent of state average: 1970: 115.3
1960: 89.2
1950: 88.1

3. Percent families below poverty level: 8.2

4. Percent of population employed: 1970: 37.9
1960: 34.1
1950: 38.6

5. Actual employment: 1970: 3,207
1960: 1,643
1950: 1,352

6. Percent of labor force unemployed: 1970: 3.1
1960: 1.2
1950: 1.6

7. Tax income to state: $106.32

8. Welfare costs to state: $6.88

9. Education costs to state: $77.31

10. Per capita surplus or deficit: $22.13 S

11. Percent employed by industry:	1970	1960	1950
agriculture	11.1 (360)	17.3	40.2 (540)
mining	1.3	0.5	0.7
construction	12.2 (394)	9.9	7.7 (104)
manufacturing	16.1 (519)	24.0	15.2
transportation	7.7	8.9	6.1
trade	15.0	14.1	10.1
services, including lodging and finance	12.2 (360)	8.3	7.8
health services and other professions	8.6	4.4	2.1
education	10.6 (343)	4.8	3.8 (51)
public administration	4.5	4.3	4.0

12. Agricultural employment has declined and manufacturing has increased but the main change has been the new identity of Douglas County as a residential community with relatively massive increases in residents employed in construction, education, and real estate-financial employment. Relative income is up to a level typical of Denver's suburban counties.

GILPIN COUNTY

County Seat: Central City; population: 228

1. 1970 population: 1,272

1a. Percent change 1960-1970: +85.7
Percent change 1950-1960: -19.4

2. Median income as percent of state average: 1970: 76.6
1960: --
1950: --

3. Percent families below poverty level: 12.7

4. Percent of population employed: 1970: 32.4
1960: 39.0
1950: 36.7

5. Actual employment: 1970: 389
1960: 267
1950: 312

6. Percent of labor force unemployed: 1970: 5.1
1960: 2.6
1950: 10.3

7. Tax income to state: $85.38

8. Welfare costs to state: $16.35

9. Education costs to state: $4.48

10. Per capita surplus or deficit: $64.55 S

11. Percent employed by industry:

	1970	1960	1950
agriculture	0.0	4.1	6.4
mining	0.0	4.1	9.9
construction	19.5	10.1	20.8
manufacturing	10.7	4.8	4.5
transportation	6.4	10.8	11.2
trade	16.4	25.8	22.8
services, including lodging and finance	27.7	10.4	6.1
health services and other professions	6.1	0.0	1.6
education	1.2	11.6	6.1
public administration	11.6	12.3	7.7

12. Recreation-related service employment picked up in the 1960's.

JEFFERSON COUNTY

County Seat: Golden; population: 9,817

1. 1970 population: 233,031

1a. Percent change 1960-1970: +82.7
Percent change 1950-1960: +129.0

2. Median income as percent of state average: 1970: 126.1
1960: 124.6
1950: 110.3

3. Percent families below poverty level: 4.1

4. Percent of population employed: 1970: 40.8
1960: 38.1
1950: 35.9

5. Actual employment: 1970: 95,000
1960: 48,527
1950: 19,971

6. Percent of labor force unemployed: 1970: 2.9
1960: 2.7
1950: 2.6

7. Tax income to state: $140.37

8. Welfare costs to state: $3.85

9. Education costs to state: $59.38

10. Per capita surplus or deficit: $77.14 S

11. Percent employed by industry:

	1970	1960	1950
agriculture	1.2	2.1	8.1
mining	1.7	1.1	0.7
construction	7.6	9.5	13.0
manufacturing	17.4	19.9	15.6
transportation	7.8	8.6	10.8
trade	22.9	20.9	21.2
services, including lodging and finance	14.9	14.4	12.8
health services and other professions	9.3	6.8	5.4
education	8.9	6.3	3.9
public administration	7.6	8.0	7.5

12. Denver Metro Area growth is typified here.

LARIMER COUNTY

County Seat: Fort Collins; population: 43,337

1. 1970 population: 89,900

1a. Percent change 1960-1970: +68.5
Percent change 1950-1960: +22.5

2. Median income as percent of state average: 1970: 93.9
1960: 86.5
1950: 89.9

3. Percent families below poverty level: 9.4

4. Percent of population employed: 1970: 37.9
1960: 36.3
1950: 34.8

5. Actual employment: 1970: 34,094
1960: 19,319
1950: 15,171

6. Percent of labor force unemployed: 1970: 5.4
1960: 4.5
1950: 4.9

7. Tax income to state: $104.10

8. Welfare costs to state: $10.72

9. Education costs to state: $45.51

10. Per capita surplus or deficit: $47.87 S

11. Percent employed by industry:

	1970	1960	1950
agriculture	6.3 (2167)	11.2	18.6 (2765)
mining	0.3	0.6	0.3
construction	7.1 (2450)	8.9	14.5 (2193) dam bldg.
manufacturing	15.1 (5175)	13.0	8.0 (1221)
transportation	4.4	6.2	5.2
trade	19.0	18.9	18.7
services, including lodging and finance	13.0	9.1	14.4
health services and other professions	9.6	5.7	4.0
education	20.5 (6995)	14.0	10.0 (1521)
public administration	4.1	4.5	4.3

12. A prosperous agricultural economy (augmented in 1950 by Reclamation construction) has grown rapidly, with fourfold increases in residents supported by manufacturing and education.

WELD COUNTY

County Seat: Greeley; population: 38,902

1. 1970 population: 89,297

1a. Percent change 1960-1970: +23.4
Percent change 1950-1960: +7.2

2. Median income as percent of state average: 1970: 87.5
1960: 81.7
1950: 87.8

3. Percent families below poverty level: 11.9

4. Percent of population employed: 1970: 37.3
1960: 34.5
1950: 32.6

5. Actual employment: 1970: 33,341
1960: 24,929
1950: 22,035

6. Percent of labor force unemployed: 1970: 4.2
1960: 3.9
1950: 5.0

7. Tax income to state: $94.72

8. Welfare cost to state: $18.34

9. Education cost to state: $50.55

10. Per capita surplus or deficit: $25.83 S

11. Percent employed by industry:

	1970	1960	1950
agriculture	14.8 (4958)	25.8	39.1 (8613)
mining	0.3 (113)	0.6	1.1 (252)
construction	7.4	7.7	6.6
manufacturing	14.5 (4837)	10.0	5.9 (1300)
transportation	5.2	6.4	5.3
trade	20.0	17.6	17.8
services, including lodging and finance	12.1	11.6	10.5
health services and other professions	8.3	5.8	3.3
education	13.7 (4569)	8.9	6.1 (1349)
public administration	3.2	3.4	2.8

12. Although agricultural employment (very diversified) halved 1950-1970, both manufacturing and education employment more than tripled to sustain substantial growth.

APPENDIX B

COLORADO AIR POLLUTION CONTROL ACT - 1970

CHAPTER 66

ARTICLE 31

AIR POLLUTION CONTROL

66-31-1. Short title.
66-31-2. Legislative declaration.
*/**66-31-3. Definitions.
66-31-4. Air pollution control commission created.
66-31-5. Duties of air pollution control commission.
**66-31-6. Commission--additional authority.
66-31-7. Commission to promulgate ambient air quality standards.
66-31-8. Commission to promulgate emission control regulations.
66-31-9. Commission--procedures to be followed in setting standards and regulations.
66-31-10. Administration of air pollution control programs.
**66-31-11. Air pollution emergencies endangering public health anywhere in this state.
**66-31-12. Air contaminant emission notices and emission permits.
**66-31-13. Enforcement.
66-31-14. Variance board.
66-31-15. Variances.
**66-31-16. Hearings.
66-31-17. Judicial review.
66-31-18. Injunctions.
66-31-19. Civil penalties.
66-31-20. Incinerators and open burning--penalties.
66-31-21. Relations with the federal government, regional agencies, and other states.
66-31-22. Organization within the department of health.
66-31-23. Application of article.
66-31-24. Temporary emission control regulations and continuance of existing orders.
66-31-25. Local government--authority--penalty.
66-31-26. Disposition of fines and penalties.
*66-31-27. Motor vehicle emissions control program.
*66-31-28. Training programs and studies--emission controls.
**66-31-29. Emission data--public availability.

(Senate Bill No. 69, 1970, EFFECTIVE DATE April 10, 1970)

*AMENDED S.B. 393, 49th GENERAL ASSEMBLY

**AMENDED H.B. 1503, 49th GENERAL ASSEMBLY

66-31-1. SHORT TITLE.--This article shall be known and may be cited as the "Air Pollution Control Act of 1970".

66-31-2. LEGISLATIVE DECLARATION.--In order to foster the health, welfare, convenience, and comfort of the inhabitants of the state of Colorado, and to facilitate the enjoyment of nature, scenery, and other resources of the state, it is hereby declared to be the policy of the state to achieve the maximum practical degree of air purity in every portion of the state. To that end, it is the purpose of this article to require the use of all available practical methods to reduce, prevent, and control air pollution throughout the entire state of Colorado, and to maintain a cooperative program between the state and local units of government. It is further declared that the prevention, abatement, and control of air pollution in each portion of the entire state are matters of statewide concern and are affected with a public interest and that the provisions of this article are enacted in the exercise of the police powers of this state for the purpose of protecting the health, peace, safety, and general welfare of the people of this state.

*/**66-31-3. DEFINITIONS.--(1) When used in this article and in regulations and orders promulgated under authority of this article, the following words and phrases shall have the meanings ascribed to them in this section:

(2) "Air contaminant" means fumes, smoke, particulate matter, vapor, gas, or any combination thereof, but not including water vapor or steam condensate.

(3) "Air contamination source" means any source whatsoever at, from, or by reason of which there is emitted or discharged into the atmosphere any air contaminant.

(4) "Air pollution control authority" means the division, or any person or agency given authority by the division, or a local governmental unit duly authorized with respect to air pollution control.

(5) "Ambient air" is the surrounding or outside air.

(6) "Commission" means the air pollution control commission created by section 66-31-4.

(7) "Division" means the division of administration of the department of health.

(8) "Emission" means the discharge or release into the atmosphere of one or more air contaminants.

(9) "Emission control regulation" means and includes any standard promulgated by regulation which is applicable to all air contamination sources within a specified area and which prohibits or establishes permissible limits for specific types of emissions in such area, and also any regulation which by its terms is applicable to a specified type of facility, process, or activity for the purpose of controlling the extent, degree, or nature of contamination emitted from such type of facility, process, or activity, and also any regulation adopted for the purpose of preventing or minimizing emission of any air contaminant in potentially dangerous quantities.

(10) "Indirect air contamination source" means any facility, building, structure, or installation, or any combination thereof, which can reasonably be expected to cause or induce substantial mobile source activity which results in emissions of air contaminants which might reasonably be expected to interfere with the attainment and maintenance of federal ambient air standards.

(11) "Local air pollution law" means any law, ordinance, resolution, code, rule or regulation adopted by the governing body of any city, town, county, or city and county, pertaining to the prevention, control and abatement of air pollution.

(12) "Motor vehicle" means any self-propelled vehicle which is designed primarily for travel on the public highways and which is generally and commonly used to transport persons and property over the public highways.

(13) "Person" means any individual, public or private corporation, partnership, association, firm, trust, estate, the state or any department, institution, or agency thereof, any municipal corporation, county, city and county, or other political subdivision of the state, or any other legal entity whatsoever which is recognized by law as the subject of rights and duties.

(14) "Variance board" means the variance board created by section 66-31-14.

66-31-4. AIR POLLUTION CONTROL COMMISSION CREATED.--(1) (a) There is hereby created in the department of health the air pollution control commission, which shall consist of nine members as follows:

(b) One member designated by the state board of health, appointed by the governor.

(c) Eight citizens of the state of Colorado who shall be appointed by the governor with the consent of the senate.

(d) Appointments to the commission shall be made so as to include appropriate scientific, technical, agricultural, and legal training within its own membership, although no specific number of its members shall be required to be so trained.

(2) (a) Initial appointments shall be for terms expiring January 30, 1971.

(b) Thereafter, terms shall be for three years, except that, of appointments made to begin on February 1, 1971, three shall be for terms expiring January 30, 1972, and three for terms expiring January 30, 1973, and two for terms expiring January 30, 1974. Thereafter, the three year terms of all appointed members shall commence on February 1 of the year of appointment. Any vacancy occurring during the term of office of any appointed member shall be filled by appointment by the governor of a qualified person for the unexpired portion of the regular term.

(3) The governor may remove any appointed member of the commission for malfeasance in office, failure to regularly attend meetings, or for any

cause that renders such a member incapable or unfit to discharge the duties of his office, and any such removal, when made, shall not be subject to review. If any member of the commission is absent from two consecutive meetings, the chairman of the commission shall determine whether the cause of such absences was reasonable. If he determines that the cause of the absences was unreasonable, he shall so notify the governor, who shall appoint a qualified person for the unexpired portion of the regular term.

(4) Each member of the commission not otherwise in full-time employment of the state shall receive a per diem of forty dollars for each day actually and necessarily spent in the discharge of official duties, but not to exceed twelve hundred dollars in any one year; and all members, ex officio and those appointed by the governor, shall receive traveling and other necessary expenses actually incurred in the performance of official duties.

(5) The governor shall appoint the chairman, vice-chairman, and secretary from among the membership of the commission for the first year of its operation, and each year thereafter the commission shall select from its own membership a chairman, vice-chairman, and secretary. The secretary of the commission shall keep a record of its proceedings. The commission shall hold regular public monthly meetings and may hold special meetings on the call of the chairman or vice-chairman at such other times as deemed necessary. Written notice of the time and place of all meetings shall be mailed by the secretary at least five days in advance of any such meetings to each member.

(6) All members, both ex officio and those appointed by the governor, shall have a vote. A majority of the commission shall constitute a quorum, and the concurrence of a majority of the commission in any matter within its powers and duties shall be required for any determination made by the commission.

66-31-5. DUTIES OF AIR POLLUTION CONTROL COMMISSION.--(1) The commission shall develop and maintain a comprehensive program for prevention, control, and abatement of air pollution throughout the entire state, including a program for control of emissions from all significant sources of air pollution, and shall promulgate ambient air goals for every portion of the state.

(2) The commission shall adopt and modify such plans for the implementation of such programs as may be necessary. Ambient air quality standards and emission control regulations shall be adopted and promulgated in accordance with sections 66-31-7 and 66-31-8.

(3) The commission shall employ a technical secretary and shall delegate to such secretary such duties and responsibilities as it may deem necessary; except, that no authority shall be delegated to such secretary to adopt, promulgate, amend, or to repeal standards or regulations, or to make determinations, or to issue or countermand orders of the commission. Such secretary shall have appropriate practical, educational, and administrative experience related to air pollution control, and shall be employed pursuant to the civil service laws of this state.

(4) The commission and the state board of health shall hold a joint public hearing during the month of October of each year in order to hear

public comment on air pollution problems within the state, alleged sources of air pollution within the state, and the availability of practical remedies therefor; and at such hearing the technical secretary shall answer reasonable questions from the public concerning administration and enforcement of the various provisions of this article, as well as rules and regulations promulgated under the authority of this article.

(5) (a) Prior to the hearing required under subsection (4) of this section, the commission shall prepare and make available to the public a report which shall contain the following specific information:

(b) A description of the pollution problem in each of the polluted areas of the state, described separately for each such area.

(c) To the extent possible, the identification of the sources of air pollution in each separate area of the state, such as motor vehicles, industrial sources, and power generating facilities.

(d) A list of all alleged violations of emission control regulations which shows the status of control procedures in effect with respect to each such alleged violation.

(6) On or before December 1 of each year, the commission shall report to the governor on the effectiveness of the provisions of this article in carrying out the legislative intent, as declared in section 66-31-2, and shall include in such report such recommendations as it may have with respect to any legislative changes that may be needed or desirable. The commission shall include in its annual report to the governor such recommendations with respect to emission standards and emission control devices for motor vehicles, aircraft, and other mobile equipment as it deems advisable.

(7) The commission shall receive all applications for hearings concerning violations and all applications for the granting of variances made pursuant to section 66-31-13 (4) or 66-31-15, and may, in its discretion, either set such applications for hearing and determination by the commission in accordance with the provisions of sections 66-31-15 and 66-31-16, or transmit such applications to the variance board for hearing and determination in accordance with the provisions of sections 66-31-15 and 66-31-16.

(8) The commission may, in its discretion, review any variance order or determination of the variance board within thirty days of the issuance thereof as provided for by section 66-31-16 (9).

**66-31-6. COMMISSION--ADDITIONAL AUTHORITY.--(1) (a) The commission shall have maximum flexibility in developing an effective air pollution control program and may promulgate such combination of regulations as may be necessary or desirable to carry out the legislative purpose set forth in section 66-31-2. Such regulations may include, but shall not be limited to:

(b) Division of the state into such control zones or areas as may be necessary or desirable for effective administration of the air pollution control program.

(c) Classification and definition of different degrees or types of air pollution.

(d) Emission control regulations that are applicable to the entire state, that are applicable only within specified areas or zones of the state, or that are applicable only when a specified class of pollution is present.

(2) The commission may hold public hearings, issue notice of hearings, issue subpoenas requiring the attendance of witnesses and the production of evidence, administer oaths, and take such testimony as it deems necessary, all in conformity with article 16 of chapter 3, C.R.S. 1963, and with sections 66-31-9 and 66-31-16.

(3) The commission may adopt such rules and regulations governing procedures before the variance board as may be necessary to assure that hearings before said board will be fair and impartial.

(4) In the event the commission, after hearing, finds and determines that a particular style or model of automobile air pollution control device is not sufficiently effective to justify the continued connection and operation of such device, the commission shall so notify the motor vehicle division of the department of revenue; thereafter, all devices of such particular style or model shall be exempt from the provisions of sections 13-5-113 and 13-5-160, C.R.S. 1963.

(5) The commission may exercise all incidental powers necessary to carry out the purposes of this article.

(6) (a) The commission may require the owner or operator, or both, of any air contamination source to:

(b) Establish and maintain reports as precribed by the commission;

(c) Install, use, and maintain monitoring equipment or methods as prescribed by the commission;

(d) Record sample emissions in accordance with such methods, at such locations, at such intervals, and in such manner as the commission shall prescribe;

(e) Provide such other information as the commission may require.

66-31-7. COMMISSION TO PROMULGATE AMBIENT AIR QUALITY STANDARDS.--(1) (a) In addition to the other powers and duties enumerated in this article, the commission shall have the power to adopt, promulgate, amend, and modify such standards for the quality of ambient air as may be appropriate or necessary to carry out the purposes of this article, including, but not limited to:

(b) Standards which describe the maximum concentrations of specifically described contaminants that can be tolerated, consistent with the protection of the good health of the public at large; such standards may differ for different parts of the state as may be necessitated by variations in altitude, topography, climate, or meteorology;

(c) Standards which describe the air quality goals that are to be achieved by control programs within specified periods of time; such standards may be either statewide or restricted to specified control areas, and

(d) Standards which describe varying degrees of contamination of ambient air.

(2) Ambient air standards shall include such requirements for test methods and procedures as will assure that the samples of ambient air tested are representative of the ambient air.

66-31-8. COMMISSION TO PROMULGATE EMISSION CONTROL REGULATIONS.--(1) (a) As promptly as possible, the commission shall adopt and promulgate emission control regulations which require the use of effective practical air pollution controls for each and every significant source, potential source, and type of source of air contamination throughout the entire state and thereafter may modify such regulations from time to time. In the formulation of each emission control regulation, the commission shall take into consideration the following:

(b) The state policy regarding air pollution, as set forth in section 66-31-2;

(c) Federal recommendations;

(d) The degree to which the concentrations of certain types of contaminants in certain portions of the state require that emission control regulations be more stringent than in other portions of the state;

(e) The degree to which any particular type of emission is subject to treatment, the availability and feasibility of control techniques, and the extent to which the emission to be controlled is significant;

(f) The continuous, intermittent, or seasonal nature of the emission to be controlled;

(g) Whether the emission control regulation should be applied throughout the entire state or only in a specified portion of the state;

(h) The need for specification of safety precautions that should be taken with respect to any source or potential source or type of source of air contamination.

(2) (a) Such emission control regulations may include, but shall not be limited to, regulations pertaining to:

(b) Visible pollutants;

(c) Particulates;

(d) Sulfur oxides, sulfuric acids, hydrogen sulfide, nitrogen oxides, carbon oxides, hydrocarbons, fluorides, and any other chemical substance;

(e) Odors;

(f) Open burning of incidental refuse, open burning at dumps, open burning for agricultural purposes, open burning of junk automobiles, and any other open burning activity;

(g) Organic solvents;

(h) Photochemical substances;

(i) Toxic gases.

(3) (a) The commission shall have the duty to identify each type of facility, process, and activity which produces or which potentially or accidentally might produce significant emissions of air contaminants, and shall promulgate an emission control regulation for each such facility, process, and activity, except for motor vehicles and airplanes to the extent prohibited by federal law. The requirements and prohibitions contained in such regulations shall be set forth with as much particularity and clarity as is practical. Upon adoption of an emission control regulation under this subsection (3) for the control of a specific facility, process, or activity, such regulation shall apply to the exclusion of other emission control regulations adopted pursuant to subsection (2) of this section; prior to such adoption the general regulations adopted pursuant to subsection (2) shall be applicable to such facility, process, or activity. Emission control regulations adopted pursuant to this section may include, but shall not be limited to, regulations pertaining to the following facilities, processes, and activities;

(b) Incinerator and incinerator design;

(c) Storage and transfer of petroleum products and any other volatile substance;

(d) Activities which frequently result in particulate matter becoming airborne, such as construction and demolition operations, and operation of parking lots;

(e) Specifications, prohibitions, and requirements pertaining to fuels and fuel additives, such as tetraethyl lead;

(f) Wigwam waste burners, pulp mills, alfalfa dehydrators, asphalt plants, and any other industrial or commercial activity which tends to emit air contaminants as a by-product;

(g) Industrial process equipment;

(h) Industrial spraying operations;

(i) Reduction of animal matter;

(j) Motor vehicles and airplanes;

(k) Diesel-powered machines, vehicles, engines, and equipment;

(l) Storage and transfer of toxic gases.

(4) Among its emission control regulations the commission shall include appropriate regulations pertaining to accidents, shutdowns, and other conditions which justify temporary relief from controls.

(5) Each emission control regulation shall be operative without regard to any ambient air quality standard unless such regulation expressly provides otherwise.

66-31-9. COMMISSION--PROCEDURES TO BE FOLLOWED IN SETTING STANDARDS AND REGULATIONS.--(1) Prior to adopting, promulgating, amending, or modifying any ambient air standard authorized in section 66-31-7, or any emission control regulation authorized in section 66-31-8, the commission shall conduct a public hearing thereon as provided in section 3-164, C.R.S. 1963. Notice of any such hearing shall conform to the requirements of section 3-16-2, C.R.S. 1963, but such notice shall be given at least sixty days prior to the hearing and shall include each proposed regulation, and shall be mailed to all persons who have filed with the commission a written request to receive such notices.

(2) Any person desiring to propose a regulation differing from the regulation proposed by the commission shall file such other proposal with the commission not less than twenty days prior to the hearing, and, when on file, such proposal shall be open for public inspection.

(3) Witnesses at the hearing shall be subject to cross-examination by or on behalf of the commission, and by or on behalf of persons who have proposed regulations pursuant to subsection (2) of this section.

(4) Regulations promulgated pursuant to sections 66-31-7 and 66-31-8 shall not take effect until thirty days after they have been filed with the secretary of state.

66-31-10. ADMINISTRATION OF AIR POLLUTION CONTROL PROGRAMS.--(1) The division shall administer and enforce the air pollution control programs adopted by the commission. In furtherance of such responsibility of the division, the executive director of the department of health shall establish within the division a separate air pollution control agency the head of which shall be a registered professional engineer or shall have a graduate degree in engineering or other specialty dealing with the problems of air pollution control. He shall also have appropriate practical and administrative experience related to air pollution control. Such person shall not be the technical secretary employed pursuant to section 66-31-5 (3). All policies and procedures followed in the administration and enforcement of the air pollution control programs which have been adopted by the commission shall be subject to supervision by the state board of health.

(2) (a) In addition to authority specified elsewhere in this article, the division shall have the power to:

(b) Conduct or cause to be conducted studies and research with respect to air pollution and the control, abatement, or prevention thereof, as requested by the commission;

(c) Determine, by means of field studies and air monitoring and sampling, if the ambient air standards are being violated in any area of the state;

(d) Enter and inspect any property, premise, or place for the purpose of investigating any actual, suspected, or potential source of air pollution or air contamination, or ascertaining compliance or noncompliance with any emission standard or any order promulgated under this article; except that if such entry or inspection is denied or not consented to, and no emergency exists, the division is empowered to and shall obtain from the district or county court for the district or county in which such property, premise, or place is located, a warrant to enter and inspect any such property, premise, or place prior to entry and inspection. The district and county courts of the state of Colorado are empowered to issue such warrants upon a proper showing of the need for such entry and inspection. Any information relating to secret process, or methods of manufacture, or production, obtained in the course of the inspection or investigation, shall be kept confidential. If samples of air or air contaminants are taken for analysis, a duplicate of the analytical reports shall be furnished promptly to the person who is suspected of causing such air pollution or air contamination;

(e) Furnish technical advice and services relating to air pollution problems and control techniques;

(f) Inform the appropriate governmental agency of the results of atmospheric tests conducted in its jurisdiction, and notify the affected city, town, county, or city and county, whenever tests establish that the ambient air or source or sources of emission of smoke or air contaminant fail to meet the standards established under this article;

(g) Designate one or more persons or agencies in any area of the state as an air pollution control authority as agent of the division to exercise and perform such powers and duties of the division as may be specified in such designation;

(h) Furnish such personnel to the variance board and the commission as the variance board and commission may reasonably require to carry out their duties and responsibilities under this article;

(i) Certify, or otherwise designate, to any other agency or department of the government of this state or of any other state or of the federal government, that any facility, land, building, machinery or equipment, or any part thereof, has been constructed, erected, installed, or acquired in conformity with the requirements of this state or of this article for control of air pollution or in conformity with the requirements for control of air pollution of any other state or the federal government.

**66-31-11. AIR POLLUTION EMERGENCIES ENDANGERING PUBLIC HEALTH ANYWHERE IN THIS STATE.--(1) (a) Whenever the division shall determine, after investigation, that any person is either engaging in any activity involving a significant risk of air contamination or is discharging or causing to be discharged into the atmosphere, directly or indirectly, any air contaminant, and such activity or discharge constitutes a clear, present, and immediate danger to the health of the public, or that any such activity or discharge of air contaminants, if permitted to continue unabated, will result in a condition of clear, present, and immediate danger to the health of the public, the division shall:

(b) Issue a written cease and desist order to said person requiring immediate discontinuance of such activity or the discharge of such contaminant into the atmosphere, and upon receipt of such order, such person shall immediately discontinue such activity or discharge; or

(c) Apply to any district court of this state for the district in which the said activity or discharge is occurring for a temporary restraining order, temporary injunction, or permanent injunction as provided for in the Colorado rules of civil procedure. Any such action in a district court shall be given precedence over all other matters pending in such district court. The institution of such injunction proceedings by the division shall confer upon said district court exclusive jurisdiction to determine finally the subject matter of the proceeding; or

(d) Both issue such a cease and desist order and apply for any such restraining order or injunction.

(2) (a) Whenever the division shall determine, after investigation, that the contaminated condition of the ambient air in any portion of this state constitutes a clear, present, and immediate danger to the health of the public, or that any activity or discharge of air contaminants, if permitted to continue unabated, will result in a condition of clear, present, and immediate danger to the health of the public, and that the procedures available to the division under subsection (1) of this section will not adequately protect the public, it shall immediately notify the governor of its determination of either of such conditions, and it shall request the governor to declare a state of air pollution emergency in such portion of this state.

(b) (i) Upon such notification and request by the division, the governor is empowered to declare a state of air pollution emergency in such portion of the state, and to take any and all actions necessary to protect the health of the public in such portion of the state, including, but not limited to:

(ii) Ordering a halt or curtailment of the movement of all motor vehicles except emergency vehicles; and

(iii) Ordering a halt or curtailment of all operations, activities, processes, or conditions which he reasonably believes to be contributing to such emergency.

(c) From time to time, whenever appropriate, the governor, in cooperation with his department heads, shall develop or modify such plans as will be necessary or appropriate to control and abate the air pollution conditions most likely to require the exercise of the powers granted in paragraph (b) of this subsection (2).

**66-31-12. AIR CONTAMINANT EMISSION NOTICES AND EMISSION PERMITS.--
(1) After ninety days from the date on which this act becomes law, no person shall permit emission of air contaminants from, or construction or alteration of, any facility, process, or activity except residential structures, from which air contaminants are, or are to be, emitted through any permanently located chimney, stack, pipe or other conduit unless and until an "air contaminant emission notice" has been filed with the division with respect to such emission. A revised emission notice shall be filed whenever a significant change in emissions is anticipated or shall have occurred.

(2) Each such notice shall specify the location at which the proposed emission will occur, the name and address of the person operating or owning such facility, process, or activity, the nature of such facility, process, or activity, and an estimate of the quantity and composition of the expected emission. The division shall make available at all air pollution control authority offices appropriate forms on which the information required by this section shall be furnished.

(3) If the information required by subsection (1) of this section is on file with the division at the time this act becomes effective, such information shall be deemed to constitute compliance with the requirements of said subsection (1) as to the emission covered thereby.

(4) (a) No person shall construct or substantially alter any building, facility, structure, or installation, except single family residential dwellings, or install any machine, equipment or other device, or commence the conduct of any activity, or commence performance of any combinations thereof, or commence operations of any of the same which will or does constitute a new air contamination source or a new indirect air contamination source without first obtaining or having a valid permit therefor from the commission; except that no permit shall be required for new indirect air contamination sources until regulations regarding permits for such sources shall have been promulgated by the commission. The commission shall establish rules, regulations, and procedures in accordance with the provisions of this article for the issuance or denial of permits which shall be in conformity with the purposes of this article as set forth in section 66-31-2, but in no event shall regulations governing indirect air contamination sources be more stringent than those required for compliance with the federal "Clean Air Act of 1970", as the same may be amended from time to time, and final rules and regulations adopted pursuant thereto. Such procedures shall include, but not be limited to, the following:

(b) Filing an application with the division which may include such relevant plans, specifications, air quality data, and other information as the division may reasonably request.

(c) The division shall prepare its preliminary analysis of the effect upon the ambient air quality and the extent of emission control within twenty days after date on which an application is filed.

(d) For those types of projects or activities defined or designated by the commission as warranting public comment with respect thereto, the division shall within fifteen days after it has prepared its preliminary analysis give public notice of the proposed project or activity by at least one publication in a newspaper of general circulation in the county in which the proposed project or activity, or a part thereof, is to be located. If no qualified newspaper is published within such county, then the publication shall be made in a newspaper published in an adjoining or nearby county. The division shall also within such period of time maintain in the office of the county clerk and recorder of the county in which the proposed project or activity, or a part thereof, is located a copy of its preliminary analysis and a copy of the application with all accompanying data for public inspection. The division shall receive and consider public comment thereon for a period of thirty days thereafter.

(e) Within thirty days following the period for public comment, or within fifteen days after the preparation of its preliminary analysis where no delay for public comment is required, the division shall grant the permit unless it determines that the proposed project or activity would not meet applicable emission standards or regulations of the commission or would interfere with the attainment or maintenance of the then existing federal primary or secondary ambient air standards; the division shall deny the permit if such standards would not be met except that when the proposed project or activity utilizes the best practical alternatives even through applicable emission control regulations and ambient air quality standards would not be met or the modification or replacement of a stationary source, by using the best practical technology, would significantly reduce emissions, the division shall consult with the commission and thereafter the division, with the concurrence of the commission, or the commission alone, may grant the permit. Any permit issued by the division may contain such terms and conditions as it deems necessary for the proposed project or activity to qualify for a permit. If any of such terms or conditions of the permit are violated, the division may revoke the permit. If the division fails to act upon the application within the prescribed time, the permit shall be deemed to have been granted.

(f) If the division denies or revokes a permit, the applicant may request a conference with the commission or a hearing before the commission in accordance with the provisions of section 66-31-16. The commision may delegate the responsibility to hold a conference or hearing with respect to any such request to the variance board.

(g) Within thirty days after such conference or hearing, the commission or variance board shall issue an order either affirming or reversing the decision of the division. If the decision or revocation of the division is reversed, the commission or variance board shall order the issuance or reinstatement of the permit which order may contain such terms and conditions as shall be necessary and reasonable. If a conference is requested in lieu of a hearing, the applicant may request a hearing thereafter if the applicant is not satisfied with the results of such conference.

(h) Orders of the commission or variance board shall be final upon the date of issuance.

(i) No person shall commence the operation of any project or the conduct of any activity for which a permit has been issued without giving at least thirty days prior notice to the division of the date on which such commencement is to take place. During such thirty-day period and again within thirty days after commencement, the division shall inspect the project or activity to determine whether or not the terms and conditions of the permit have been properly satisfied. If the division finds that the terms or conditions of the permit have been violated it may revoke the permit, or it may grant a period of not more than six months in which the terms or conditions may be satisfied. If the division determines that the terms and conditions of the permit have not been satisfied within such period of time, the division shall revoke the permit. If the division determines that the terms and conditions of the permit have been satisfied, the division shall grant its final approval of the permit whereupon all requirements of this subsection (4) shall have been fulfilled by the applicant.

(j) Any permit issued under prior existing law with respect to a project or the operation thereof shall continue in full force and effect and shall not be affected by the terms hereof and the holder of such a permit shall not be required to comply with the provisions hereof. Regulations concerning permits for the construction and operation of new direct air contamination sources in effect as of July 1, 1973, and not inconsistent with the provisions of this article shall continue in effect until repealed or amended from time to time by the commission.

**66-31-13. ENFORCEMENT.--(1) The division shall enforce compliance with the emission control regulations promulgated pursuant to the provisions of section 66-31-8.

(2) In case any written and verified complaint shall be filed with the division alleging that, or in case the division itself shall have cause to believe that, any person is violating any emission control regulation, the division shall cause a prompt investigation to be made, and if the person who makes such investigation on behalf of the division shall find after such investigation that a violation of any such regulation exists, he shall promptly so notify both the alleged violator and the commission in writing. Thereupon the division shall diligently endeavor to obtain voluntary abatement of such violation.

(3) After notice has been given pursuant to subsection (2) of this section, but in no event later than six months after the giving of such notice, if the alleged violation has not been abated, the division shall cause to be issued and served upon the person allegedly violating any such regulation, a written order which shall specify the provision of the emission control regulation of which such person is said to be in violation, and a statement of the manner in which such person is said to violate it, and such order shall require the person so complained against to cease and desist from such violation within such reasonable time as the division may determine, but not to exceed six months.

(4) (a) (i) Within twenty days after receipt of such order, if subsection (4) (a) (ii) or (iii) of this section is applicable; and, at the election of the recipient of the order, either within twenty days after receipt of such order or on or before thirty days prior to the effective date of said order, if subsection (4) (a) (iv) is applicable, the recipient thereof may file with the commission or the variance board a written petition requesting a hearing to determine any one of the following matters:

(ii) Whether or not the alleged violation exists or did exist;

(iii) Whether or not the alleged violation exists or did exist and whether or not a variance should be granted with respect to any violation determined to exist or have existed;

(iv) Whether or not a variance should be granted with respect to such violation.

(b) In no event shall the recipient have the right to separate hearings to determine the matters described in paragraph (a) of this subsection (4), provided always in the case of a hearing provided for in subparagraph (iii) of paragraph (a), the commission or variance board shall render its final determination of whether or not the alleged violation exists or did exist before proceeding to take or hear evidence or make any final determination based thereon as to whether or not a variance should be granted with respect to an alleged violation; and further provided the commission or variance board may authorize separate hearings to determine the matters described in said paragraph (a) (iii) if it is determined that such separate hearings are necessary and proper for a fair and impartial hearing under the circumstances.

(c) Except with respect to actions taken pursuant to section 66-31-11, upon the filing of such a request with the commission or variance board, the order shall be stayed pending the final determination of the petition by the commission or variance board.

66-31-14. VARIANCE BOARD.--(1) (a) There is hereby created a variance board which shall consist of nine members as follows:

(b) One member designated by the state board of health to represent said board in matters of air pollution in the interests of the public health of the people of the state;

(c) One member shall be a registered professional engineer with at least five years' experience in the actual practice of his profession, and who is not from industry;

(d) One member, who is not from industry, shall be either a physician licensed to practice in this state, or a toxicologist;

(e) Three members from industry in this state;

(f) Three members, as representatives of the public at large, not from industry.

(2) All members appointed under the provisions of paragraphs (c) to (f) of this subsection (1) shall be appointed by the governor.

(3) All members appointed by the governor shall hold office for terms of four years and until their successors are selected and qualified. The member designated by the state board of health shall serve at the discretion of the state board of health. There shall be no limitation on the number of terms any appointed member may serve. If any member of the variance board appointed by the governor shall resign or be removed from the variance board, the governor shall promptly appoint a new member, as provided in this section, to fill the vacancy for the remainder of the term of the member of the variance board who has ceased to be a member thereof.

(4) The governor shall appoint alternates for all members of the variance board appointed by him. Each such alternate shall have the same qualifications as the member for which appointed. Each alternate shall be appointed for a term which shall terminate on the same date as that of the member for which appointed. An alternate shall act as a member of the variance board, only when the member for whom appointed fails or refuses to so act, and when so acting, the alternate shall have all the rights, powers, duties, and functions of a member of the variance board. Alternates shall be compensated as provided in subsection (9) of this section.

(5) The governor may remove any appointed member of the variance board for malfeasance in office, failure to regularly attend meetings, or for any cause that renders such a member incapable or unfit to discharge the duties of his office, and any such removal, when made, shall not be subject to review. If any member of the variance board is absent from two consecutive meetings, the chairman of the variance board shall determine whether the cause of such absences was reasonable. If he determines that the cause of the absences was unreasonable, he shall so notify the governor, who shall appoint a qualified person for the unexpired portion of the regular term.

(6) (a) The variance board shall:

(b) Elect its chairman annually from its members for a term of one year;

(c) Meet at least quarterly, but special meetings of the variance board may be called by its chairman upon his own initiative, or by the commission, and such a meeting shall be called by him upon the receipt by him of a written request therefor, signed by two or more members of said variance board;

(d) Keep a record of its proceedings.

(7) Five members shall constitute a quorum, and the concurrence of at least a majority of all members of the variance board in any matter within its powers and duties shall be required for any determination made by the said variance board.

(8) At least three days prior to each meeting, written notice shall be given to each member of the variance board of the time, place, and purpose of such meeting.

(9) Each member of the variance board shall receive a per diem of forty dollars for each day actually spent in the discharge of official duties, not to exceed twelve hundred dollars in any one year; and shall be reimbursed for necessary and actual expenses incurred in the performance of his duties under this article.

(10) The individuals serving as members of the air pollution variance board as existing pursuant to article 29 of chapter 66, C.R.S. 1963, as that article existed on January 1, 1970, shall serve as the variance board created by this article until the expiration dates of the respective terms to which they have been appointed.

66-31-15. VARIANCES.--(1) (a) The variance board or commission may grant a variance, suspending or modifying the enforcement of any emission control regulation, or any rule, regulation, or enforcement order issued pursuant to this article against any person, whenever the said variance board or commission shall determine that:

(b) Control techniques are not available or that compliance with applicable emission control regulations from which a variance is sought would create an unreasonable economic burden; and

(c) That the granting of such variance would be consistent with, and aid in, implementing the legislative policy as set forth in section 66-31-2.

(2) The variance board or the commission shall grant a variance suspending or modifying the enforcement of any emission control regulation, or any rule, regulation, or enforcement order issued pursuant to this article against any person, whenever the said variance board or the commission shall determine that strict compliance with any provision of, or order issued pursuant to, this article would result in an arbitrary and unreasonable taking of property or in the practical closing of any lawful business or activity and such would be without sufficient corresponding public benefit.

(3) The variance shall be granted, terminated, or modified by the variance board or the commission only after a hearing before it, held pursuant to the provisions of this article. A variance may be granted with respect to any existing or proposed facility, process, or activity. Hearings may be requested either by the variance board, the commission, the division, or by any person applying for or having received such a variance.

(4) Any variance granted pursuant to the provisions of this article shall be granted for such period of time and under such conditions as shall be specified by the variance board or the commission. The failure to meet any condition of the variance without prior written permission of the said variance board or the commission shall render such variance null and void. The variance board shall review, at least annually, any variance that has been granted to determine whether the terms and conditions of said variance have been complied with, and whether the continuance of the variance is justified.

(5) Nothing in this section, and no variance or renewal granted pursuant hereto, shall be construed to prevent or limit the application of the emergency provisions of section 66-31-11.

(6) The variance board shall have the power to hold public hearings, conduct investigations, compel the attendance of witnesses, receive such pertinent and relevant proof and do such other things as it may deem to be necessary, proper, or desirable in order that it may effectively discharge its duties and responsibilities under this article; all in conformity with article 16 of chapter 3, C.R.S. 1963, and with regulations of the commission adopted pursuant to section 66-31-6.

**66-31-16. HEARINGS.--(1) Not less than fifteen days after a hearing has been requested, the variance board or the commission, as the case may be, shall grant such request and set a time and place therefor. Every such hearing shall be conducted pursuant to the provisions of this article and the provisions of article 16 of chapter 3, C.R.S. 1963.

(2) The division shall appear as a party in any hearing before the variance board or the commission and shall have the same rights to judicial review as any other party.

(3) All testimony taken at any such hearing before the variance board or the commission shall be under oath or affirmation. A full and complete record of all proceedings and testimony presented shall be taken and filed. The stenographer shall furnish, upon payment and receipt of any fees allowed therefor, a certified transcript of the whole or any part of his record to any party in such hearing requesting the same.

(4) Any information relating to secret processes, methods of manufacture or production, which may be required, ascertained, or discovered, shall not be publicly disclosed in public hearings or otherwise, and shall be kept confidential by any member, officer, or employee of the variance board, the commission or the division, but any person seeking to invoke the protection of this section in any hearing for a variance shall bear the burden of proving its applicability.

(5) At any hearing, any person who is affected by the proceeding and whose interests are not already adequately represented, shall have the opportunity to be a party thereto upon prior application to and approval by the variance board or commission, in its sole discretion, as deemed reasonable and proper by said variance board and commission, and such person shall have the right to be heard and to cross-examine any witness.

(6) After due consideration of the written and oral statements, the testimony, and the arguments presented at any such hearing, the variance board or commission shall enter its findings and final order, based upon evidence in the record, or make such final determination of the matter as it shall deem appropriate.

(7) In all proceedings before the variance board or the commission with respect to any alleged violation of any emission control regulation or order, the burden of proof shall be upon the division.

(8) The applicant for a variance shall bear the burden of proof.

(9) Variances, orders, and determinations of the variance board shall become final within thirty days from the date on which they are issued, unless within such period the variance board grants a rehearing, or unless within such period the commission concludes that said variance, order, or determination interferes with the attainment of the objectives of this article, as set forth in section 66-31-2. If the commission so concludes, it shall, within said thirty-day period, notify the applicant of such conclusion, including the nature of the interference involved, and allow the applicant ten days in which to request a hearing before the commission on said variance, order, or determination, which hearing shall be set and held in accordance with the provisions of section 66-31-15 and of this section. Following the hearing before the commission, or if no hearing is requested, the commission shall enter its final order affirming or modifying said variance, order, or determination.

(10) Every hearing granted by the variance board or the commission shall be conducted by either body or by a hearing officer designated by either body, and every hearing shall comply with the provisions of this article and the provisions of article 16 of chapter 3, C.R.S. 1963.

66-31-17. JUDICIAL REVIEW.--(1) Any final order or determination by the variance board, the division, or the commission, shall be subject to a judicial review in accordance with the provisions of this article and the provisions of article 16 of chapter 3, C.R.S. 1963. Such final order or determination shall be stayed pending the decision of the court.

(2) Any party may move the court to remand the case to the variance board, the division, or the commission in the interests of justice, for the purpose of adducing additional specified and material evidence, and findings thereon; but such party shall show reasonable grounds for the failure to adduce such evidence previously before the variance board, the division, or the commission.

(3) Any proceeding for judicial review of any final order or determination of the variance board, the division, or the commission shall be filed in the district court for the district in which is located the air contamination source affected, and shall be filed within twenty days after the date of said final order or determination.

66-31-18. INJUNCTIONS.--In the event any person fails to comply with a cease and desist order that is not subject to a stay pending administrative or judicial review, the commission may request the district attorney for the district in which the alleged violation exists, or the attorney general, to bring, and if so requested it shall be his duty to bring, a suit for an injunction to prevent any further or continued violation of such order. In any such suit the final findings of the division or commission, based upon evidence in the record, shall be prima facie evidence of the fact or facts found therein.

66-31-19. CIVIL PENALTIES.--(1) (a) Penalties shall be determined and collected by a court of competent jurisdiction upon action instituted by the division for the determination and collection of said penalty under this section, and in accordance with the following provisions:

(b) Any person who shall violate any final cease and desist order which is not subject to a stay pending judicial review and which has been issued either pursuant to article 29 of chapter 66 prior to adoption of this article or pursuant to this article shall be subject to a civil penalty of not more than two thousand five hundred dollars per day for each day during which such violation occurs.

(c) On and after July 1, 1970, any person failing to comply with the provisions of section 66-31-12 (1) shall be subject to a civil penalty of not more than one hundred dollars.

66-31-20. INCINERATORS AND OPEN BURNING--PENALTIES.--(1) (a) The commission shall adopt a program to control incinerator burning and open burning in each portion of the state in which such control is necessary in order to carry out the policies of this article as set forth in section 66-31-2. Such program shall include emission control regulations and the designation, after public hearing and from time to time, of such portions by legal description.

(b) Open burning in the course of agricultural operations may be regulated only where the absence of regulations would substantially impede the commission in carrying out the objectives of this act. In adopting any program applicable to agricultural operations, the commission shall take into consideration the necessity of conducting open burning.

(2) (a) Within such designated portions of the state, no person shall burn or permit to be burned in any incinerator or on any open premises owned or controlled by him, or on any public street, alley, or other land adjacent to such premises, any rubbish, waste paper, wood, or other flamable material, unless a permit therefor shall first have been obtained from the appropriate air pollution control authority. In granting or denying the issuance of any such permit, said authority shall base its action on the location and proximity of such burning to any building or other structure, the potential contribution of such burning to air pollution in the area, climatic conditions on the day or days of such burning, and compliance by the applicant for the permit with applicable fire protection and safety requirements of the local authority or area.

(b) In all or any part of any portion of the state designated pursuant to subsection (1) of this section the prohibition contained in this subsection (2) may be suspended by the commission with respect to any particular type or category of incinerator or open burning upon a finding that enforcement of the prohibition would neither significantly assist in the prevention, abatement, and control of air pollution, nor significantly enhance the quality of the ambient air in such designated area.

(3) Any person who violates subsection (2) (a) of this section by burning or permitting any burning without first having obtained a permit as

required shall be subject to a civil penalty of not more than one hundred dollars per day for each day during which such a violation occurs.

66-31-21. RELATIONS WITH THE FEDERAL GOVERNMENT, REGIONAL AGENCIES, AND OTHER STATES.--(1) The department of health shall serve as the state agency for all purposes of the federal "Clean Air Act", as amended, and regulations promulgated under said act, and shall accept and supervise the administration of loans and grants from the federal government and from other sources, public or private, which are received by the state for air pollution control purposes.

(2) As promptly as possible the commission shall hold a public hearing and adopt ambient air quality standards for the Denver air quality control region which has heretofore been designated by the federal government.

(3) The department of health may enter into agreements with any air pollution control agencies of the federal government, or other states, and with regional air pollution control agencies, but any such agreement involving, authorizing, or requiring compliance in this state with any ambient air standard or emission control regulation shall not be effective unless or until the commission has held a hearing with respect to such standard or regulation and has adopted the same in compliance with section 66-31-9.

66-31-22. ORGANIZATION WITHIN THE DEPARTMENT OF HEALTH.--The air pollution control commission, together with the variance board and the technical secretary under said commission, shall exercise their powers and perform their duties and functions specified in this article in the department of health as if the same were transferred to the department by a "Type 1" transfer, as such transfer is defined in the "Administrative Organization Act of 1968", being chapter 53, Session Laws of Colorado 1968.

66-31-23. APPLICATION OF ARTICLE.--(1) The factual or legal basis for proceedings or other actions that shall result from a violation of any emission control regulation inure solely to, and shall be for the benefit of the people of the state generally, and it is not intended to create by this article, in any way, new or enlarged private rights or to enlarge existing private rights, or to diminish private rights. A determination that air pollution or air contamination exists or that any standard has been disregarded or violated, whether or not a proceeding or action may be brought by the state, shall not create by reason thereof any presumption of law or finding of fact which shall inure to or be for the benefit of any person other than the state.

(2) Other than section 66-31-11, the provisions of this article and regulations adopted hereunder shall not apply to air contamination insofar as such contamination exists within the confines of a particular commercial or industrial plant, works, or shop which is the source of air contamination, and shall not apply or affect the relations between employers and employees, with respect to, or arising out of, any condition of air contamination.

(3) It is the purpose of this article to provide additional and cumulative remedies to prevent and abate air pollution and air contamination. Nothing in this article shall abridge or alter rights of action or remedies now or hereafter existing, nor shall any provision of this article or any-

thing done by virtue of this article be construed as estopping individuals, cities, towns, counties, cities and counties, or duly constituted political subdivisions of the state, from the exercise of their respective rights to suppress nuisances.

66-31-24. TEMPORARY EMISSION CONTROL REGULATIONS AND CONTINUANCE OF EXISTING ORDERS.--(1) Upon the effective date hereof, the commission shall be deemed to have adopted temporary emission control regulations whose provisions are identical to the provisions of section 66-29-5 (2) through (6), as those subsections existed on January 1, 1970, and such regulations shall be in full force and effect in each area of the state which was designated by the division pursuant to section 66-29-8 (1) (c), as that paragraph existed on January 1, 1970, and such temporary emission control regulations shall remain in full force and effect until modified, altered, or revoked by the commission.

(2) All actions, orders, and determinations by the division of administration and the state board of health pursuant to article 29 of chapter 66, as that article existed on January 1, 1970, shall remain in full force and effect until countermanded or modified by the division.

(3) All actions, orders, and determinations of the air pollution variance board created by article 29 of chapter 66, as that article existed on January 1, 1970, shall remain in full force and effect until countermanded or modified by the variance board created by this article.

66-31-25. LOCAL GOVERNMENT--AUTHORITY--PENALTY.--(1) Home rule cities, cities, towns, counties, and cities and counties are hereby authorized to enact local air pollution laws. Every such law shall provide for variances, hearings, judicial review, and injunctions consistent with sections 66-31-15 to 66-31-18, and shall include emission control regulations which are at least the same as or may be more restrictive than the emission control regulations adopted pursuant to this article; except that, nothing contained in this article shall prohibit any such local law from controlling any air contamination or air contamination source which is not subject to control under the provisions of this article; and except that, no variance or permit issued under any local air pollution law with respect to any facility, activity, or process, shall ever be construed to relieve any holder thereof from the duty to maintain such facility, activity, or process in compliance with the emission control regulations adopted pursuant to this article, nor to relieve the division from its duty to enforce such emission control regulations with respect to such facility, activity, or process.

(2) All local air pollution laws and orders issued pursuant thereto in existence at the time this article takes effect are hereby validated as though adopted pursuant to the authority of subsection (1) of this section; but if any such local law or order fails to meet the requirements of this article, the governing body under whose authority such law or order was promulgated shall have until July 1, 1971, to amend, modify, or repeal the same so that it will meet the requirements of this article, but if not so amended, modified, or repealed, the same shall be superseded by this article.

(3) To the extent a local air pollution law adopted by a county is more restrictive than such a law adopted by any city or town within such county, the county law shall apply in lieu of the city or town law to the extent of the inconsistency.

(4) Application, operation, and enforcement of valid local air pollution laws shall be completely independent of but may be concurrent with the application, operation, and enforcement of this article. The appointment of an air pollution control authority by the division shall in no way affect the duties and responsibilities given the same person or agency under a local air pollution law, and the appointment of an air pollution control authority by a local governmental unit shall in no way affect the duties and responsibilities given the same person or agency by the division.

(5) Any local governmental authority enforcing air pollution control regulations which shall issue any enforcement order or grant any variance shall, at the time of such issuance or granting, transmit to the commission a copy of such order or variance.

(6) In order to assure coordination of efforts to control and abate air pollution, at least semiannually the commission and each air pollution control authority created by a local air pollution law shall confer and review each other's records concerning the area subject to such local law and coordinate their respective plans and programs for such area.

(7) No local air pollution control authority shall institute any system or program that conflicts with, or is in any way inconsistent with, air pollution emergency plans promulgated by the governor pursuant to section 66-31-11 (2).

(8) Subject to such variances as may be issued pursuant to a local air pollution law, any person who shall violate any emission control regulation specified in any local air pollution law, within the jurisdiction of the local government unit enacting the same, shall be subject to a civil penalty of not more than three hundred dollars. Each day during which such a violation occurs shall be deemed a separate offense.

66-31-26. DISPOSITION OF FINES AND PENALTIES.--All receipts from penalties or fines collected under the provisions of sections 66-31-19 and 66-31-20 shall be credited to the general fund of the state.

*66-31-27. MOTOR VEHICLE EMISSIONS CONTROL PROGRAM.--(1) The commission shall have the authority to adopt regulations concerning high altitude tuning specifications to control motor vehicle emissions in this state.

(2) The departments of revenue and health shall develop joint programs where appropriate for the control of motor vehicle emissions. Though the departments of health and revenue shall confer and cooperate in all aspects of the motor vehicle emission control program, the primary responsibility of the commission is the adoption of rules and regulations, and the primary responsibility of the department of revenue is the enforcement of those rules and regulations as delegated pursuant to 66-31-10 (2) (g).

(3) Not later than December 1, 1973, the departments of health and revenue are directed to complete certain pilot and testing programs and

studies and make joint recommendations to the governor and to the general assembly.

(4) (a) The department of health shall develop a pilot program for the purpose of testing a representative sample of motor vehicles with various vehicle emission control alternatives which may include emission testing and maintenance, air pollution control tuneup, and vehicle modification alternatives as determined by the commission.

(b) Based upon the results of the pilot program, the commission shall develop recommendations for implementing programs of emission testing or mandatory maintenance, or both; air pollution control tuneups; and vehicle modifications, including altitude modifications and retrofit control systems, for the control of motor vehicle emissions. Such recommendations shall include information on the costs and air pollution control effectiveness of alternate control measures and legislative and regulatory measures necessary to implement an effective program. Any program recommended shall be based upon establishing statewide minimum standards and shall include more stringent standards for motor vehicles registered in air quality control basins defined by the commission.

*66-31-28. TRAINING PROGRAMS AND STUDIES--EMISSION CONTROLS.--(1) No later than July 1, 1974, state-employed investigators shall complete a training course and pass qualification tests as developed and approved by the commission, after conferring with the department of revenue, as related to the orientation and basic maintenance procedures on air pollution control systems installed by manufacturers. The commission may waive the requirement for completion of such a training course under such circumstances as the commission deems appropriate. Only inspectors passing said qualification tests shall perform emission inspections. The commission may require, pursuant to section 13-5-113, C.R.S. 1963, that inspection stations have on hand by July 1, 1974 any equipment necessary to complete emission inspections as provided for in this section.

(2) The departments of health and revenue shall jointly recommend, by December 1, 1973, additional training programs which may be necessary to help implement motor vehicle emission control measures.

(3) No later than February 1, 1974, pilot training programs consistent with the provisions of this section shall have been completed to determine program costs and effectiveness in meeting the training requirements of this section.

(4) (a) The departments of health and revenue jointly shall recommend a program to insure consumer protection in the implementation of the motor vehicle emission control program. The departments shall make recommendations relating to penalties and enforcement procedures that will not only be effective in the control of emissions, but also allow persons in violation reasonable time to comply with any requirements established.

(b) The commission shall consider, in promulgating rules and regulations, the adverse effect of said rules and regulations upon gasoline mileage, performance, or other factors as to any make, model, or class of motor vehicles as well as the public benefit in reducing air pollution. The commission may make recommendations to exempt from regulations any make or model of motor vehicle for which either gas mileage, performance, or other factor would be adversely affected in a significant manner by said control measures.

(c) Any make or model of motor vehicle, fueled by natural gas, or powered by electrical energy, or powered by a Rankin cycle engine, shall be exempt from the provisions of section 66-31-27.

**66-31-29. EMISSION DATA--PUBLIC AVAILABILITY.--Notwithstanding any other provisions of this article, or any other law to the contrary, all emission data received or obtained by the commission or the variance board shall be available to the public to the extent required by the federal "Clean Air Act of 1970" as the same may be amended from time to time.

For reference purposes, the following sections are included:

Chapter 13, Section 5, Operation of Vehicles

**	13-5-113	Periodical Inspections Required
**	13-5-160	Air Pollution Control Devices - Tampering - Operation of Vehicle

Chapter 40, Colorado Criminal Code

**	40-13-110	Air Pollution Violations
	40-1-107	Petty Offenses Classified
	40-8-503	Perjury in the Second Degree

13-5-113 (2), Colorado Revised Statutes 1963 (1969 Supp.), is repealed and reenacted, with amendments, to read:

13-5-113. PERIODICAL INSPECTIONS REQUIRED.--(2) (a) The inspection required by this section shall include an inspection of the lights, brakes, steering assemblies, window and windshield glass, exhaust system, mufflers, fenders, and any other equipment or accessory, the proper functioning of which is found by the department of revenue to be necessary to the safe operation of the vehicle.

(b) Except as to devices found by the air pollution control commission to be ineffective pursuant to section 66-31-6 (4), C.R.S. 1963, the inspection required by this section shall include the crank case ventilating system on gasoline propelled automobiles and trucks manufactured in the United States after July 1, 1965, and on all other motor vehicles equipped with the same, connection of air pollution control devices installed by the manufacturer of any automobile of a model year of 1968 or later, and any other inspection prescribed pursuant to paragraph (c) of this subsection (2).

(c) Effective July 1, 1973, as part of the inspection required by this section, the air pollution control commission is authorized to adopt regulations pursuant to sections 66-31-8 and 66-31-9, C.R.S. 1963, for the proper connection and operation of air pollution control devices installed by the manufacturer in any motor vehicle for the purpose of controlling vehicle emissions; the air pollution control commission may further adopt rules and regulations governing other air pollution control devices; which rules and regulations shall be enforced by the department of revenue. Such rules and regulations pertaining to inspections for the proper operation of all pollution control devices shall not become effective before July 1, 1974, and prior to that time, the air pollution control commission shall recommend to the general assembly an appropriate fee therefor.

(d) Effective with the sale of inspection certificates to be issued after July 1, 1973, there shall be a fee of fifteen cents in addition to that prescribed by section 13-5-114 (5), which fee shall be paid to the department of revenue along with the fee paid under section 13-5-114 (4), and shall be credited to the special account prescribed by section 13-5-114 (4) and may be used, subject to appropriation by the general assembly, to cover the cost of the motor vehicle emissions control activities of the departments of health and revenue.

13-5-160. AUTOMOBILE AIR POLLUTION CONTROL DEVICES--TAMPERING--OPERATION OF VEHICLE.--(1) No person shall knowingly disconnect, deactivate, or otherwise render inoperable any air pollution control device which has been installed by the manufacturer of any automobile of a model year of 1968 or later.

(2) No person shall operate on any highway in this state any automobile described in subsection (1) of this section knowing that any air pollution control device installed on such automobile has been disconnected, deactivated, or otherwise rendered inoperable.

(3) Any person who violates any provision of this section shall be guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine of not less than ten dollars nor more than one hundred dollars, or by imprisonment in the county jail for not more than ten days, or by both such fine and imprisonment.

(4) The air pollution control commission may adopt rules and regulations pursuant to sections 66-31-8 and 66-31-9, C.R.S. 1963, which permit or allow for the alteration, modification, or disconnection of manufacturer-installed air pollution control systems or manufacturer tuning specifications on motor vehicles for the purpose of controlling vehicle emissions. Nothing in this section shall prohibit the alteration or the conversion of a motor vehicle to operate on a gaseous fuel, providing that the resultant emissions are at levels complying with state and federal standards for that model year of motor vehicle.

40-1-107. PETTY OFFENSES CLASSIFIED, PENALTIES.--A violation of a statute of this state is a "petty offense" if specifically classified as a class 1 or class 2 petty offense. The penalty for commission of a class 1 petty offense is a fine of not more than five hundred dollars or imprisonment for not more than six months other than in the state penitentiary, or both. The penalty for commission of a class 2 petty offense is a fine specified in the section defining the offense. The penalty assessment procedure of section 40-1-305 is available for the payment of fines in class 2 petty offense cases.

Editor's note: Section 40-1-305 has been repealed.

40-13-110. AIR POLLUTION VIOLATIONS.--(1) (a) (i) It is a class 2 petty offense as specified in section 40-1-107 for any person to cause air pollution by any of the means:

(ii) To cause or permit, in any air pollution control region designated by the commission in which more than thirty times per year the carbon monoxide level exceeds nine parts per million averaged over an eight hour period, the emission into the atmosphere from any motor vehicle powered by gasoline, or other fuel except diesel, of any visible air contaminant (except water vapor) for a period greater than five consecutive seconds; except that no two-cycle gasoline-powered motor vehicle shall emit into the atmosphere any air contaminant (except water vapor) of a shade or density equal to or greater than twenty percent opacity for a period greater than ten consecutive seconds;

(iii) To cause or permit the emission into the atmosphere from any diesel-powered motor vehicle operating not more than at an altitude of eight thousand feet above mean sea level any air contaminant (except water vapor) of a shade or density equal to or greater than thirty percent opacity for a period greater than ten consecutive seconds, other than as a result of a cold engine start-up;

(iv) To cause or permit the emission into the atmosphere from any diesel-powered motor vehicle operating at more than eight thousand feet above mean sea level any air contaminant (except water vapor) of a shade or density equal to or greater than forty percent opacity for a period greater than ten consecutive seconds, other than as a result of a cold engine start-up;

(b) Opacity is defined as the degree to which an air contaminant emission obscures the view of an observer, expressed in percentage of the obscuration or in the degree (percent) to which transmittance of light is reduced by an air contaminant emission.

(2) (a) The air pollution control commission shall establish training requirements for peace officers charged with the enforcement of the provisions of subsection (1) of this section.

(b) In addition to the enforcement of the provisions of subsection (1) of this section by peace officers, the air pollution enforcement officers of the department of health, including designated air pollution agents of the department, shall enforce the provisions of this section and, for such purposes only, shall have the powers of peace officers.

(3) (a) Effective January 1, 1974, the offense of causing air pollution as defined in this section is punishable by a fine of twenty-five dollars. Penalty assessment procedures provided in section 39-2-201, C.R.S. 1963, shall be utilized in the enforcement of this section and shall be subject to the additional provisions of this subsection (3). Prior to such

date, peace officers may issue notices warning of conditions which appear to violate the provisions of this section.

(b) Copies of every notice issued on or after January 1, 1974, shall be forwarded by the issuing officer to the Colorado department of revenue, motor vehicle division, and to the clerk of the county court of the appropriate county. The notice, in the form of a summons and complaint, shall provide that the person charged may pay the specified fine in person or by mail at the office of the Colorado department of revenue, motor vehicle division, Denver, Colorado, within seven days after the date of issuance of the notice, shall specify a date not less than thirty nor more than sixty days after its date of issuance for appearance to answer the charge if the fine is not paid, and shall further give notice that, in the alternative, the person may have the charge dismissed by complying with the provisions of paragraph (c) of this subsection (3).

(c) Upon presentation to the court, by mail or in person, of an affidavit by the owner of the vehicle described in the penalty assessment notice that the vehicle has been disposed of in such manner that it will no longer be operated on the highways, together with the registration card and number plates of such vehicle, the complaint shall be dismissed. Likewise, upon presentation, by mail or in person, of an affidavit of the owner that such automobile has been repaired prior to the date set for appearance upon the charge and that it is not in violation of the provisions of this section when in normal operation, the complaint shall be dismissed. Any such affidavit is subject to the penalties of perjury in the second degree if made in violation of the provisions of section 40-8-503.

40-8-503. PERJURY IN THE SECOND DEGREE. A person commits perjury in the second degree if, other than in an official proceeding, with an intent to mislead a public servant in the performance of his duty, he makes a materially false statement, which he does not believe to be true, under an oath required or authorized by law. Perjury in the second degree is a class 1 misdemeanor.

APPROPRIATION.--(1) In addition to any other appropriation, there is hereby appropriated out of any moneys in the state treasury not otherwise appropriated, to the department of health, for the fiscal year beginning July 1, 1973, the sum of three hundred eighty thousand nine hundred fifty-one dollars ($380,951), or so much thereof as may be necessary, for the motor vehicle emissions control program authorized by this act. These funds shall be used to develop within the department of health a motor vehicle emissions control section, to develop a pilot program for the testing of vehicle emission control alternates, to develop training programs, and to develop other measures and recommendations in line with the intent of this act.

(2) In addition to any other appropriation, there is hereby appropriated out of any moneys in the special account within the highway users tax fund prescribed by section 13-5-114 (4), C.R.S. 1963, not otherwise appropriated, to the department of revenue, for the fiscal year beginning July 1, 1973, the sum of twenty-five thousand fifty-nine dollars ($25,059), or so much thereof as may be necessary, for the performance of its duties in the implementation of this act.

APPENDIX C

40 CFR 52, SUBPART G - COLORADO

Subpart G—Colorado

§ 52.320 Identification of plan.

(a) Title of plan: "Air Quality Implementation Plan for State of Colorado".

(b) The plan was officially submitted on January 26, 1972.

(c) Supplemental information was submitted on:

(1) February 14, and March 20, 1972;

(2) May 1, 1972, by the Colorado Air Pollution Control Commission;

(3) May 1, 1972, by the Colorado Air Pollution Control Division, and

(4) June 4, 1973, and July 16, 1973.

§ 52.321 Classification of regions.

The Colorado plan was evaluated on the basis of the following classifications:

Air quality control region	Pollutant				
	Particulate matter	Sulfur oxides	Nitrogen dioxide	Carbon monoxide	Photochemical oxidants (hydrocarbons)
Pawnee Intrastate	I	III	III	III	III
Metropolitan Denver Intrastate	I	III	III	I	I
Comanche Intrastate	III	III	III	III	III
San Isabel Intrastate	I	III	III	III	III
San Luis Intrastate	III	III	III	III	III
Four Corners Interstate	IA	IA	III	III	III
Grand Mesa Intrastate	III	III	III	III	III
Yampa Intrastate	III	III	III	III	III

[39 FR 16344, May 8, 1974]

§ 52.322 Extensions.

(a) The Administrator hereby extends for 18 months the statutory timetable for submission of Colorado's plan for attainment and maintenance of the secondary standards for particulate matter in the Metropolitan Denver, San Isabel, and Pawnee Intrastate Regions.

(b) The Administrator hereby extends until May 31, 1977, the attainment date for the national standards for carbon monoxide and photochemical oxidants in the Metropolitan Denver Intrastate Air Quality Control Region.

§ 52.323 Approval status.

With the exceptions set forth in this subpart, the Administrator approves Colorado's plan for the attainment and maintenance of the national standards.

§ 52.324 Legal authority.

(a) The requirements of § 51.11(a)(6) of this chapter are not met since the State lacks the authority to require owners or operators of stationary sources to install, maintain, and use emission monitoring devices and to make periodic reports to the State on the nature and amounts of emissions from such stationary sources.

(b) Delegation of authority: Pursuant to section 114 of the Act, Colorado requested a delegation of authority to enable it to require sources to install and maintain monitoring equipment and to report periodically on the nature and amount of their emissions. The Administrator has determined that Colorado is qualified to receive a delegation of the authority it requested. Accordingly, the Administrator delegates to Colorado his authority under section 114(a)(1) (B) and (C) of the Act, i.e., authority to require sources within the State of Colorado to install and maintain monitoring equipment and to report periodically on the nature and amount of their emissions.

§ 52.323 Attainment dates for national standards.

The following table presents the dates by which the national standards are to be attained. These dates reflect the information presented in Colorado's plan, except where noted.

Air quality control region	Pollutant						
	Particulate matter		Sulfur oxides		Nitrogen dioxide	Carbon monoxide	Photochemical oxidants (hydrocarbons)
	Primary	Secondary	Primary	Secondary			
Pawnee Intrastate	a	b	d	d	d	d	d
Metropolitan Denver Intrastate	a	b	d	d	d	May 31, 1977	May 31, 1977
Comanche Intrastate	d	d	d	d	d	d	d
San Isabel Intrastate	a	b	d	d	d	d	d
San Luis Intrastate	c	a	d	d	d	d	d
Grand Mesa Intrastate	a	a	d	d	d	d	d
Yampa Intrastate	d	d	d	d	d	d	d
Four Corners Interstate	a	a	d	d	d	d	d

[39 FR 16344, May 8, 1974]

NOTE.—Footnotes which are underlined are prescribed by the Administrator because the plan did not provide a specific date or the date provided was not acceptable.

a. July 1975.
b. 18-month extension granted.
c. Air quality levels presently below primary standards.
d. Air quality levels presently below secondary standards.

§ 52.326 Transportation and land use controls.

(a) To complete the requirements of § 51.11(b) of this part, the Governor of Colorado must submit to the Administrator.

(1) No later than July 1, 1974, the legislative authority necessary for carrying out control measures for which full authority does not yet exist, namely inspection/maintenance air bleed retrofit, and high-altitude modification, specified on pages 7-13 and 7-14 of the plan submitted June 4, 1973, and in the supplemental submission of July 16, 1973.

(2) No later than January 31, 1974, the adopted regulations and administrative policies necessary for carrying out the control measures for which the State now has legal authority, namely the designation of bus/carpool lanes, the limitation of constructing parking facilities, and the restriction of on-street parking, specified in the supplemental submission of July 16, 1973.

(3) No later than September 1, 1974, the adopted regulations and administrative policies necessary for carrying out any control measure for which the State must submit legal authority in accordance with paragraph (a)(1) of this section.

§ 52.327 Compliance schedules.

(a) The requirements of § 51.15(c) of this chapter are not met since compliance schedules with adequate increments of progress have not been submitted for every source for which they are required.

§ 52.328 Control Strategy: Photochemical oxidants (hydrocarbons) and carbon monoxide.

(a) The requirements of § 51.14 of this chapter are not met because the plan does not provide for attainment and maintenance of the national standards for photochemical oxidants (hydrocarbons) and carbon monoxide in the Metropolitan Denver Intrastate Air Quality Control Region by May 31, 1977.

§ 52.329 Rules and regulations.

(a) The requirements of § 51.22 are not met since regulations for the control of stationary hydrocarbon regulations necessary for the attainment of the national standards for photochemical oxidants have not been submitted or adopted.

§ 52.330 Gasoline limitations.

(a) Definitions:

(1) "Distributor" means any person or entity that transports or stores or causes the transportation or storage of gasoline between any refinery and any retail outlet.

(2) "Retail outlet" means any establishment at which gasoline is sold or offered for sale to the public, or introduced into any vehicle.

(b) This section is applicable within the Metropolitan Denver Intrastate Air Quality Control Region (hereafter referred to as the Region) to all distributors of gasoline to any retail outlet in the Region, and to the owners and operators of all retail outlets in the Region.

(c) If the Administrator determines, on the basis of air quality monitoring in the Region, that the national ambient air quality standards for carbon monoxide and photochemical oxidants will not be attained in the Region by May 31, 1977, the Administrator shall implement a program, to be effective no later than May 31, 1977, limiting the total gallonage of gasoline delivered to retail outlets to that amount which, when combusted, will not result in such ambient air quality standards being exceeded.

(d) All distributors to which this section applies shall provide the Administrator with a detailed annual accounting of the amount of gasoline delivered to each retail outlet in the region for calendar year 1976, and for each calendar year during which the gasoline limitation program is in effect. The owner or operator of each retail outlet to which this section applies shall provide the Administrator with a detailed accounting of gasoline received from each distributor, the total amount of gasoline sold during the year, and the amount of gasoline on hand at the beginning and end of the year, for each year during which the gasoline limitation program is in effect. All accountings required by this section shall be provided no later than 90 days after the end of the applicable year. The Administrator may require any other reports that he may deem necessary for the implementation of this section.

§ 52.331 Control of dry cleaning solvent evaporation.

(a) "Drycleaning operation" means that process by which an organic solvent, as defined in § 52.333(k), is used in the commercial cleaning of garments and other fabric materials.

(b) This section is applicable in the Metropolitan Denver Intrastate Air Quality Control Region.

(c) No person shall operate a dry cleaning operation using other than perchloroethylene, 1,1,1-trichloroethane, or saturated halogenated hydrocarbons unless the uncontrolled organic emissions from such operation are reduced at least 85 percent, except that dry cleaning operations emitting less than 3 pounds per hour and less than 15 pounds per day of uncontrolled organic materials are exempt from the requirements of this section.

(d) If incineration is used as a control technique, 90 percent or more of the carbon in the organic compounds being incinerated must be oxidized to carbon dioxide. Compliance with this requirement shall be in accordance with the provisions of § 52.338.

(e) Any owner or operator of a source subject to this section shall achieve compliance with the requirements of paragraph (c) of this section by discontinuing the use of photochemically reactive solvents as defined by § 52.333(1) no later than January 31, 1974, or by controlling emission as required by paragraphs (c) and (d) of this section in accordance with the requirements of § 52.338.

§ 52.332 Degreasing operations.

(a) "Degreasing" means the operation of using an organic solvent as a surface cleaning agent.

(b) This section is applicable in the Metropolitan Denver Intrastate Air Quality Control Region.

(c) No person shall use for degreasing any organic solvent other than 1,1,1-trichloroethane, perchloroethylene, or saturated halogenated hydrocarbons after January 31, 1974, unless the uncontrolled organic emissions from such operation have been reduced at least 85 percent overall.

(d) Degreasing operations emitting less than 3 pounds per hour and less than 15 pounds per day of uncontrolled organic materials are exempt from the requirement of this section.

(e) If incineration is used as a control technique, 90 percent or more of the carbon in the organic compounds being incinerated must be oxidized to carbon dioxide. Compliance with this paragraph shall be in accordance with the provisions of § 52.338.

(f) Any owner or operator of a stationary source subject to this section shall achieve compliance with the requirements of paragraph (c) of this section by discontinuing the use of any organic solvent other than 1,1,1-trichloroethane, percloroethylene, or saturated halogenated hydrocarbons no later than January 31, 1974, or by controlling emissions as required by paragraphs (c) and (e) of this section in accordance with the requirements of § 52.338.

§ 52.333 Organic solvent usage.

(a) This section is applicable in the Metropolitan Denver Intrastate Air Quality Control Region. Compliance with the requirements of paragraphs (b) through (l) of this section shall be in accordance with the provisions of § 52.338.

(b) No person shall discharge more than 15 pounds of organic materials into the atmosphere in any one day nor more than 3 pounds in any one hour from any article, machine, equipment or other contrivance in which any organic solvent or any material containing organic solvent comes into contact with flame or is baked, heat-cured, or heat polymerized, in the presence of oxygen, unless all organic materials discharged from such article, machine, equipment, or other contrivance have been reduced by at least 85 percent overall.

(c) No person shall discharge more than 40 pounds of organic material into the atmosphere in any one day or more than 8 pounds in any one hour from any article, machine, equipment, or other contrivance used under conditions other than described in paragraph (b) of this section for employing, applying, evaporating, or drying any photochemically reactive solvent, as defined in paragraph (1) of this section, or material containing such solvent, unless all organic materials discharged from such article, machine, equipment, or other contrivance have been reduced by at least 85 percent overall.

(d) Any series of articles, machines, equipment, or other contrivances designed for processing a continuously moving sheet, web, strip, or wire which is subjected to any combination of operations described in paragraphs (b) and (c) of this section involving any photochemically reactive solvent, as defined in paragraph (l) of this section, or material containing such solvent, shall be subject to compliance with paragraph (c) of this section. Where only non-photochemically reactive solvents or materials containing only non-photochemically reactive solvents are employed or applied, and where any portion or portions of said series of articles, machines, equipment, or other contrivances involves operations described in paragraph (b) of this section, said portions shall be collectively subject to compliance with paragraph (b) of this section.

(e) Emissions of organic materials to the atmosphere from the cleanup with photochemically reactive solvent, as defined in paragraph (l) of this section, of any article, machine, equipment, or other contrivance described in paragraphs (b), (c), or (d) of this section shall be included with the other emissions of organic materials from that article, machine, equipment, or other contrivance for determining compliance with this section.

(f) Emissions of organic materials into the atmosphere as a result of continuous drying of products during the first 12 hours after their removal from any article, machine, equipment, or other contrivance described in paragraphs (b), (c), or (d) of this section shall be included with other emissions of organic materials from that article, machine, equipment or other contrivance for determining compliance with this section.

(g) Emissions of organic materials into the atmosphere required to be controlled by paragraphs (b), (c), or (d) of this section shall be controlled by:

(1) Incineration: *Provided*, That 90 percent or more of the carbon in the organic material being incinerated is oxidized to carbon dioxide,

(2) Adsorption, or

(3) Processing in a manner determined by the Administrator to be not less effective than the methods described in paragraphs (g) (1) or (2) of this section.

(h) A person incinerating, adsorbing, or otherwise processing organic materials pursuant to this section shall provide, properly install and maintain in calibration, in good working order and in operation, devices as specified in the authority to construct or the permit to operate, or as specified by the Administrator, for indicating temperatures, pressures, rates of flow or other operating conditions necessary to determine the degree and effectiveness of air pollution control.

(i) Any person using organic solvents or any materials containing organic solvents shall supply the Administrator, upon request and in the manner and form prescribed by him written evidence of the chemical composition, physical properties and amount consumed for each organic solvent used.

(j) The provisions of this section shall not apply to:

(1) The manufacture, transport, or storage of organic solvents or materials containing organic solvents.

(2) The spraying or other employment of insecticides, pesticides, or herbicides.

(3) The employment, application, evaporation, or drying of saturated halogenated hydrocarbons, 1,1,1-trichloroethane, or perchloroethylene.

(4) The use of any material in any article, machine, equipment, or other contrivance described in paragraphs (b), (c), (d), or (e) of this section, if:

(i) The volatile content of such material consists only of water and organic solvents,

(ii) The organic solvents comprise not not more than 20 percent by volume of said volatile content,

(iii) The volatile content is not photochemically reactive as defined in paragraph (1) of this section, and

(iv) The organic solvent or any material containing organic solvent does not come into contact with flame.

(5) The use of any material in any article, machine, equipment, or other contrivance described in paragraphs (b), (c), (d), or (e) of this section, if:

(i) The organic solvent content of such material does not exceed 20 percent by volume of said material,

(ii) The volatile content is not photochemically reactive as defined in paragraph (1) of this section,

(iii) More than 50 percent by volume of such volatile material is evaporated before entering a chamber heated above ambient application temperature, and

(iv) The organic solvent or any material containing organic solvent does not come into contact with flame.

(j) The use of any material, in any article, machine, equipment, or other contrivance described in paragraphs (b), (c), (d), or (e) of this section, if:

(i) The organic solvent content of such material does not exceed 5 percent by volume of said material,

(ii) The volatile content is not photochemically reactive as defined in paragraph (l) of this section, and

(iii) The organic solvent or any material containing organic solvent does not come into contact with flame.

(k) For the purposes of this section, organic solvents include diluents and thinners and are defined as organic materials which are liquids at standard conditions and which are used as dissolvers, viscosity reducers, or cleaning agents.

(l) For the purposes of this section, a photochemically reactive solvent is any solvent with an aggregate of more than 20 percent of its total volume composed of the chemical compounds classified below or which exceeds any of the following individual percentage composition limitations, referred to the total volume of solvent:

(1) A combination of hydrocarbons, alcohols, aldehydes, esters, ethers, or ketones having an olefinic or cyclo-olefinic type of unsaturation: 5 percent;

(2) A combination of aromatic compounds with eight or more carbon atoms to the molecule except ethylbenzene: 8 percent;

(3) A combination of ethylbenzene or ketones having branched hydrocarbon structures, trichloroethylene or toluene: 20 percent.

(m) Whenever any organic solvent or any constituent of an organic solvent may be classified from its chemical structure into more than one of the above groups of organic compounds, it shall be considered as a member of the most reactive chemical group, that is, that group having the least allowable percent of the total volume of solvents.

(n) For the purpose of this section, organic materials are defined as chemical compounds of carbon excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides, metallic carbonates, and ammonium carbonate.

(o) This section shall be effective on the date of its adoption for any article, machine, equipment, or other contrivance not then completed and put into service. As for all other articles, machines, equipment, or other contrivances, compliance shall be required in accordance with § 52.338.

(p) A person shall not, after May 31, 1975, discharge into the atmosphere more than 3,000 pounds of organic materials in any one day nor more than 450 pounds in any one hour from any article, machine, equipment, or other contrivance in which any non-photochemically reactive solvent or any material containing such solvent is employed or applied, unless said discharge has been reduced by at least 85 percent. Emissions of organic materials into the atmosphere resulting from air or heated drying of products for the first 12 hours after their removal from any article, machine, equipment, or other contrivance described in this section shall be included in determining compliance with this section. Emissions resulting from baking, heat-curing, or heat-polymerizing shall be excluded from determination of compliance with this section. Those portions of any series of articles, machines, equipment, or other contrivances designed for processing a continuous web, strip, or wire which emit organic materials and using operations described in this section shall be collectively subject to compliance with this section.

§ 52.334 Storage of petroleum products.

(a) This section is applicable in the Metropolitan Denver Intrastate Air Quality Control Region. Compliance with the requirements of paragraph (b) of this section shall be in accordance with the provisions of § 52.338.

(b) No person shall place, store or hold in any stationary tank, reservoir, or other container of more than 40,000 gallons capacity any gasoline or any petroleum distillate having a vapor pressure of 1.5 pounds per square inch absolute (psia) or greater under actual storage conditions, unless such tank, reservoir or other container is a pressure tank maintaining working pressures sufficient at all times to prevent hydrocarbon vapor or gas loss to the atmosphere, or is designed and equipped with one of the following vapor loss control devices, properly installed, in good working order, and in operation:

(1) A floating roof, consisting of a pontoon type or double deck type roof, resting on the surface of the liquid contents and equipped with a closure seal, or seals, to close the space between the roof edge and tank wall. The control equipment provided for in this paragraph shall not be used if the gasoline or petroleum distillate has a vapor pressure of 11.0 pounds per square inch absolute or greater under actual storage conditions. All tank gauging and sampling devices shall be gas-tight except when gauging or sampling is taking place.

(2) A vapor recovery system, consisting of a vapor gathering system capable of collecting the hydrocarbon vapors and gases discharged and a vapor disposal system capable of processing such hydrocarbon vapors and gases so as to prevent their emission to the atmosphere, with all tank gauging and sampling devices gas-tight, except when gauging or sampling is taking place.

(3) Other equipment of equal efficiency, provided such equipment is approved by the Administrator.

§ 52.335 Organic liquid loading.

(a) "Loading facility" means any aggregation or combination of organic liquid loading equipment which is both possessed by one person and located so that all the organic liquid loading outlets for such aggregation or combination of loading equipment can be encompassed within any circle of 300 feet in diameter.

(b) This section is applicable in the Metropolitan Denver Intrastate Air Quality Control Region. Compliance with the requirements of paragraphs (b) through (d) of this section shall be in accordance with the provisions of § 52.338.

(c) No person shall load organic liquids having a vapor pressure of 1.5 psia or greater under actual loading conditions into any tank truck, trailer, or railroad tank car from any loading facility unless the loading facility is equipped with a vapor collection and disposal system, or its equivalent, approved by the Administrator.

(d) Loading shall be accomplished in such a manner that all displaced vapor and air will be vented only to the vapor collection system. Measures shall be taken to prevent liquid drainage from the loading device when it is not in use or to accomplish complete drainage before the loading device is disconnected.

(e) The vapor disposal portion of the vapor collection and disposal system shall consist of one of the following:

(1) An absorber system or condensation system which processes all vapors and recovers at least 90 percent by weight of the organic vapors and gases from the equipment being controlled.

(2) A vapor handling system which directs all vapors to a fuel gas system.

(3) Other equipment of equal efficiency provided such equipment is approved by the Administrator.

(f) This section shall apply only to the loading of organic liquids having a vapor pressure of 1.5 psia or greater under actual loading conditions at a facility from which at least 20,000 gallons of such organic liquids are loaded in any one day.

§ 52.336 Gasoline transfer vapor control.

(a) "Gasoline" means any petroleum distillate having a Reid vapor pressure of 4 pounds or greater.

(b) This section is applicable in the Metropolitan Denver Intrastate Air Quality Control Region.

(c) No person shall transfer gasoline from any delivery vessel into any stationary storage container with a capacity greater than 250 gallons unless such container is equipped with a submerged fill pipe and unless the displaced vapors from the storage container are processed by a system that prevents release to the atmosphere of no less than 90 percent by weight of organic compounds in said vapors displaced from the stationary container location.

(1) The vapor recovery portion of the system shall include one or more of the following:

(i) A vapor-tight return line from the storage container to the delivery vessel and a system that will ensure that the vapor return line is connected before gasoline can be transferred into the container.

(ii) Refrigeration-condensation system or equivalent designed to recover no less than 90 percent by weight of the organic compounds in the displaced vapor.

(2) If a "vapor-tight vapor return" system is used to meet the requirements of this section, the system shall be so constructed as to be readily added on to retrofit with an adsorption system, refrigeration-condensation system, or equivalent vapor removal system, and so constructed as to anticipate compliance with § 52.337.

(3) The vapor-laden delivery vessel shall be subject to the following conditions:

(i) The delivery vessel must be so designed and maintained as to be vapor-tight at all times.

(ii) The vapor-laden delivery vessel may be refilled only at facilities equipped with a vapor recovery system or the equivalent, which can recover at least 90 percent by weight of the organic compounds in the vapors displaced from the delivery vessel during refilling.

(iii) Gasoline storage compartments of 1,000 gallons or less in gasoline delivery vehicles presently in use on the promulgation date of this regulation will not be required to be retrofitted with a vapor return system until January 1, 1977.

(d) The provisions of this paragraph (c) shall not apply to the following:

(1) Stationary containers having a capacity less than 550 gallons used exclusively for the fueling of implements of husbandry.

(2) Any container having a capacity less than 2,000 gallons installed prior to promulgation of this paragraph.

(3) Transfer made to storage tanks equipped with floating roofs or their equivalent.

(e) Compliance schedule:

(1) *June 1, 1974.* Submit to the Administrator a final control plan, which describes at a minimum the steps which will be taken by the source to achieve compliance with the provisions of paragraph (c) of this section.

[39 FR 4880, February 8, 1974]

(2) *November 1, 1974.* Negotiate and sign all necessary contracts for emission control systems, or issue orders for the purchase of component parts to accomplish emission control.

[39 FR 4880, February 8, 1974]

(3) *January 1, 1975.* Initiate on-site construction or installation of emission control equipment.

[39 FR 4880, February 8, 1974]

(4) *February 1, 1976.* Complete on-site construction or installation of emission control equipment.

(5) *March 1, 1976.* Assure final compliance with the provisions of paragraph (c) of this section.

(6) Any owner or operator of sources subject to the compliance schedule in this paragraph shall certify to the Administrator, within 5 days after the deadline for each increment of progress, whether or not the required increment of progress has been met.

(f) Paragraph (e) of this section shall not apply:

(1) To a source which is presently in compliance with the provisions of paragraph (c) of this section and which has certified such compliance to the Administrator by June 1, 1974. The Administrator may request whatever supporting information he considers necessary for proper certification.

[39 FR 4880, February 8, 1974]

(2) To a source for which a compliance schedule is adopted by the State and approved by the Administrator.

(3) To a source whose owner or operator submits to the Administrator, by June 1, 1974, a proposed alternative schedule. No such schedule may provide for compliance after March 1, 1976. If promulgated by the Administrator, such schedule shall satisfy the requirements of this paragraph for the affected source.

[39 FR 4880, February 8, 1974]

(g) Nothing in this paragraph shall preclude the Administrator from promulgating a separate schedule for any source to which the application of the compliance schedule in paragraph (e) of this section fails to satisfy the requirements of § 51.15 (b) and (c) of this chapter.

(h) Any gasoline dispensing facility subject to this regulation which installs a storage tank after the effective date of this regulation shall comply with the requirements of paragraph (c) of this section by March 1, 1976. Any facility subject to this regulation which installs a storage tank after March 1, 1976, shall comply with the requirements of paragraph (c) at the time of installation.

§ 52.337 Control of evaporative losses from the filling of vehicular tanks.

(a) "Gasoline" means any petroleum distillate having a Reid vapor pressure of 4 pounds or greater.

(b) This section is applicable in the Metropolitan Denver Intrastate Air Quality Control Region.

(c) A person shall not transfer gasoline to an automotive fuel tank from gasoline dispensing system unless the transfer is made through a fill nozzle designed to:

(1) Prevent discharge of hydrocarbon vapors to the atmosphere from either the vehicle filler neck or dispensing nozzle;

(2) Direct vapor displaced from the automotive fuel tank to a system wherein at least 90 percent by weight of the organic compounds in displaced vapors are recovered; and

(3) Prevent automotive fuel tank overfills or spillage on fill nozzle disconnect.

(d) The system referred to in paragraph (c) of this section can consist of a vapor-tight vapor return line from the fill nozzle-filler neck interface to the dispensing tank, to an adsorption, absorption, incineration, refrigeration-condensation system or equivalent.

(e) Components of the systems required by § 52.336(c) can be used for compliance with paragraph (c) of this section.

(f) If it is demonstrated to the satisfaction of the Administrator that it is impractical to comply with the provisions of paragraph (c) of this section as a result of vehicle fill neck configuration, location, or other design features, the provisions of this paragraph shall not apply to such vehicles. However, in no case shall such configuration exempt any gasoline dispensing facility from installing a system required by paragraph (c).

(g) Compliance schedule:

(1) *January 1, 1975.* Submit to the Administrator a final control plan, which describes at a minimum the steps which will be taken by the source to achieve compliance with the provisions of paragraph (c) of this section.

[39 FR 4880, February 8, 1974; 39 FR 21049, June 18, 1974]

(2) *March 1, 1975.* Negotiate and sign all necessary contracts for emission control systems, or issue orders for the purchase of component parts to accomplish emission control.

[39 FR 4880, February 8, 1974; 39 FR 21049, June 18, 1974]

(3) *May 1, 1975.* Initiate on-site construction or installation of emission control equipment.

[39 FR 21049, June 18, 1974]

(4) *May 1, 1977.* Complete on-site construction or installation of emission control equipment or process modification.

(5) *May 31, 1977.* Assure final compliance with the provisions of paragraph (c) of this section.

(6) Any owner or operator of sources subject to the compliance schedule in this paragraph shall certify to the Administrator, within 5 days after the deadline for each increment of progress, whether or not the required increment of progress has been met.

(h) Paragraph (g) of this section shall not apply:

(1) To a source which is presently in compliance with the provisions of paragraph (c) of this section and which has certified such compliance to the Administrator by January 1, 1975. The Administrator may request whatever supporting information he considers necessary for proper certification.

[39 FR 4880, February 8, 1974; 39 FR 21049, June 18, 1974]

(2) To a source for which a compliance schedule is adopted by the State and approved by the Administrator.

(3) To a source whose owner or operator submits to the Administrator, by June 1, 1974, a proposed alternative schedule. No such schedule may provide for compliance after May 31, 1977. If promulgated by the Administrator, such schedule shall satisfy the requirements of this paragraph for the affected source.

[39 FR 4880, February 8, 1974]

(i) Nothing in this paragraph shall preclude the Administrator from promulgating a separate schedule for any source to which the application of the compliance schedule in paragraph (g) of this section fails to satisfy the requirements of § 51.15 (b) and (c) of this chapter.

(j) Any gasoline dispensing facility subject to this regulation which installs a gasoline dispensing system after the effective date of this regulation shall comply with the requirements of paragraph (c) of this section by May 31, 1977. Any facility subject to this regulation which installs a gasoline dispensing system after May 31, 1977, shall comply with the requirements of paragraph (c) of this section at the time of installation.

§ 52.338 Federal compliance schedules.

(a) Except as provided in paragraph (c) of this section, the owner or operator of any stationary source subject to the requirements of §§ 52.331, 52.332, 52.333, 52.334, and 52.335 shall comply with the compliance schedule in paragraph (b) of this section.

(b) Compliance schedule:

(1) *December 17, 1973.* Submit to the Administrator a final control plan, which describes, at a minimum, the steps which will be taken by the source to achieve compliance with the sections cited in paragraph (a) of this section.

(2) *February 16, 1974.* Negotiate and sign all necessary contracts for emission control systems or process modifications, or issue orders for the purchase of component parts to accomplish emission control or process modification.

(3) *July 1, 1974.* Initiate on-site construction or installation of emission control equipment or process modification.

(4) *May 1, 1975.* Complete on-site construction or installation of emission control equipment or process modification.

(5) *May 31, 1975.* Assure final compliance with the sections cited in paragraph (a) of this section.

(6) Any owner or operator of stationary sources subject to the compliance schedule in this paragraph shall certify to the Administrator, within 5 days after the deadline for each increment of progress, whether or not the required increment of progress has been met.

(c) Paragraph (b) of this section shall not apply:

(1) To a source which is presently in compliance with the regulations cited in paragraph (a) of this section and which has certified such compliance to the Administrator by December 15, 1973. The Administrator may request whatever supporting information he considers necessary for proper certification.

(2) To a source for which a compliance schedule is adopted by the State and appoved by the Administrator.

(3) To a source whose owner or operator submits to the Administrator, by December 15, 1973, a proposed alternative schedule. No such schedule may provide for compliance after May 31, 1975. If promulgated by the Administrator such schedule shall satisfy the requirements of this paragraph for the affected source.

(d) Nothing in this paragraph shall preclude the Administrator from promulgating a separate schedule for any source to which the application of the compliance schedule in paragraph (b) of this section fails to satisfy the requirements of § 51.15 (b) and (c) of this chapter.

§ 52.339 Monitoring transportation controls.

(a) This section is applicable to the Metropolitan Denver Intrastate Region.

(b) The State of Colorado, or a designated agency approved by the Administrator, shall monitor the transportation control measures approved for the State's implementation plan as follows:

(1) The actual per vehicle emission reductions occurring as a result of:

(i) Inspection/maintenance;

(ii) Airbleed (pre-1968 light-duty vehicles); and

(iii) High altitude modification (1968–1974 light-duty vehicles).

(2) The observed changes in vehicle miles traveled (VMT) and average vehicle speeds as a result of:

(i) Bus/carpool lanes;

(ii) Parking lot construction limitation;

(iii) Limitation of on-street parking; and

(iv) Mass transit improvements.

(c) No later than January 15, 1974, the State shall submit to the Administrator a detailed program demonstrating compliance with paragraph (b) of this section and in accordance with § 51.19(d) of this chapter. The program description shall include the following:

(1) The agency or agencies responsible for conducting, overseeing, and maintaining the monitoring program.

(2) The administrative process to be used.

(3) A description of the methods to be used to collect the vehicle emission reductions, and changes in VMT and average vehicle speed, including a description of any modeling techniques to be employed.

(4) The funding requirements, including a signed statement from the Governor or the State Treasurer or their respective designees identifying the source and amount of funds for the program.

(d) No later than February 15, 1974, the Administrator will approve or disapprove the proposed monitoring program.

(e) All data collected as a result of the monitoring program shall be submitted to the Administrator on a semiannual basis beginning August 15, 1974. The data shall be submitted in a format similar to that presented in Appendix M to Part 51 of this chapter.

§ 52.340 Review of new sources and modifications.

(a) The requirements of § 51.18 of this chapter are not met because the State failed to submit a plan for the review of new or modified indirect sources.

(b) *Regulation for review of new or modified indirect sources.* The provisions of § 52.22(b) of this chapter are hereby incorporated by reference and made a part of the applicable implementation plan for the State of Colorado.

APPENDIX D

HOUSE BILL 1041

1974

An Act

HOUSE BILL NO. 1041. BY REPRESENTATIVES Dittemore, Buechner, Herzberger, Miller, Pettie, Eaker, Eckelberry, Friedman, Gustafson, Hamlin, Koster, O'Brian, Ross, Sack, Sonnenberg, and Tempest; also SENATORS Allshouse, Darby, Johnson, Plock, H. Brown, DeBerard, L. Fowler, Garnsey, Jackson, Klein, McCormick, Schieffelin, Stockton, and Strickland.

CONCERNING LAND USE, AND PROVIDING FOR IDENTIFICATION, DESIGNATION, AND ADMINISTRATION OF AREAS AND ACTIVITIES OF STATE INTEREST, AND ASSIGNING ADDITIONAL DUTIES TO THE COLORADO LAND USE COMMISSION AND THE DEPARTMENT OF LOCAL AFFAIRS, AND MAKING APPROPRIATIONS THEREFOR.

Be it enacted by the General Assembly of the State of Colorado:

SECTION 1. Chapter 106, Colorado Revised Statutes 1963, as amended, is amended BY THE ADDITION OF A NEW ARTICLE to read:

ARTICLE 7

Areas and Activities of State Interest

PART 1

GENERAL PROVISIONS

106-7-101. Legislative declaration. (1) In addition to the legislative declaration contained in section 106-4-1 (1), the general assembly further finds and declares that:

(a) The protection of the utility, value, and future of all lands within the state, including the public domain as well as privately owned land, is a matter of the public interest;

Capital letters indicate new material added to existing statutes; dashes through words indicate deletions from existing statutes and such material not part of act.

(b) Adequate information on land use and systematic methods of definition, classification, and utilization thereof are either lacking or not readily available to land use decision makers;

(c) It is the intent of the general assembly that land use, land use planning, and quality of development are matters in which the state has responsibility for the health, welfare, and safety of the people of the state and for the protection of the environment of the state.

(2) It is the purpose of this article that:

(a) The general assembly shall describe areas which may be of state interest and activities which may be of state interest and establish criteria for the administration of such areas and activities;

(b) Local governments shall be encouraged to designate areas and activities of state interest and, after such designation, shall administer such areas and activities of state interest and promulgate guidelines for the administration thereof; and

(c) Appropriate state agencies shall assist local governments to identify, designate, and adopt guidelines for administration of matters of state interest.

106-7-102. General definitions. As used in this article, unless the context otherwise requires:

(1) "Development" means any construction or activity which changes the basic character or the use of the land on which the construction or activity occurs.

(2) "Local government" means a municipality or county.

(3) "Local permit authority" means the governing body of a local government with which an application for development in an area of state interest or for conduct of an activity of state interest must be filed or the designee thereof.

(4) "Matter of state interest" means an area of state interest or an activity of state interest or both.

(5) "Municipality" means a home rule or statutory city, town, or city and county or a territorial charter city.

(6) "Person" means any individual, partnership, corporation, association, company, or other public or corporate body, including the federal government, and includes any political subdivision, agency, instrumentality, or corporation of the state.

106-7-103. Definitions pertaining to natural hazards. As used in this article, unless the context otherwise requires:

(1) "Aspect" means the cardinal direction the land surface faces, characterized by north-facing slopes generally having heavier vegetation cover.

(2) "Avalanche" means a mass of snow or ice and other material which may become incorporated therein as such mass moves rapidly down a mountain slope.

(3) "Corrosive soil" means soil which contains soluble salts which may produce serious detrimental effects in concrete, metal, or other substances that are in contact with such soil.

(4) "Debris-fan floodplain" means a floodplain which is located at the mouth of a mountain valley tributary stream as such stream enters the valley floor.

(5) "Dry wash channel and dry wash floodplain" means a small watershed with a very high percentage of runoff after torrential rainfall.

(6) "Expansive soil and rock" means soil and rock which contains clay and which expands to a significant degree upon wetting and shrinks upon drying.

(7) "Floodplain" means an area adjacent to a stream, which area is subject to flooding as the result of the occurrence of an intermediate regional flood and which area thus is so adverse to past, current, or foreseeable construction or land use as to constitute a significant hazard to public health and safety or to property. The term includes but is not limited to:

(a) Mainstream floodplains;

(b) Debris-fan floodplains; and

(c) Dry wash channels and dry wash floodplains.

(8) "Geologic hazard" means a geologic phenomenon which is so adverse to past, current, or foreseeable construction or land use as to constitute a significant hazard to public health and safety or to property. The term includes but is not limited to:

(a) Avalanches, landslides, rock falls, mudflows, and unstable or potentially unstable slopes;

(b) Seismic effects;

(c) Radioactivity; and

(d) Ground subsidence.

(9) "Geologic hazard area" means an area which contains or is directly affected by a geologic hazard.

(10) "Ground subsidence" means a process characterized by the downward displacement of surface material caused by natural phenomena such as removal of underground fluids, natural consolidation, or dissolution of underground minerals or by man-made phenomena such as underground mining.

(11) "Mainstream floodplain" means an area adjacent to a perennial stream that is subject to periodic flooding.

(12) "Mudflow" means the downward movement of mud in a mountain watershed because of peculiar characteristics of extremely high sediment yield and occasional high runoff.

(13) "Natural hazard" means a geologic hazard, a wildfire hazard, or a flood.

(14) "Natural hazard area" means an area containing or directly affected by a natural hazard.

(15) "Radioactivity" means a condition related to various types of radiation emitted by natural radioactive minerals that occur in natural deposits of rock, soil, and water.

(16) "Seismic effects" means direct and indirect effects caused by an earthquake or an underground nuclear detonation.

(17) "Siltation" means a process which results in an excessive rate of removal of soil and rock materials from one location and rapid deposit thereof in adjacent areas.

(18) "Slope" means the gradient of the ground surface which is definable by degree or percent.

(19) "Unstable or potentially unstable slope" means an area susceptible to a landslide, a mudflow, a rock fall, or accelerated creep of slope-forming materials.

(20) "Wildfire behavior" means the predictable action of a wildfire under given conditions of slope, aspect, and weather.

(21) "Wildfire hazard" means a wildfire phenomenon which is so adverse to past, current, or foreseeable construction or land use as to constitute a significant hazard to public health and safety or to property. The term includes but is not limited to:

(a) Slope and aspect;

(b) Wildfire behavior characteristics; and

(c) Existing vegetation types.

(22) "Wildfire hazard area" means an area containing or directly affected by a wildfire hazard.

106-7-104. Definitions pertaining to other areas and activities of state interest. As used in this article, unless the context otherwise requires:

(1) "Airport" means any municipal or county airport or airport under the jurisdiction of an airport authority.

(2) "Area around a key facility" means an area immediately and directly affected by a key facility.

(3) "Arterial highway" means any limited-access highway which is part of the federal-aid interstate system or any limited-access highway constructed under the supervision of the state department of highways.

(4) "Collector highway" means a major thoroughfare serving as a corridor or link between municipalities, unincorporated population centers or recreation areas, or industrial centers and constructed under guidelines and standards established by, or under the supervision of, the state department of highways. Collector highway does not include a city street or local service road or a county road designed for local service and constructed under the supervision of local government.

(5) "Domestic water and sewage treatment system" means a wastewater treatment plant, water treatment plant, or water supply system, as defined in section 66-38-2 (6), (7), and (8), C.R.S. 1963, and any system of pipes, structures, and facilities through which wastewater is collected for treatment.

(6) "Historical or archaeological resources of statewide importance" means resources which have been officially included in the national register of historic places, designated by statute, or included in an established list of places compiled by the state historical society.

(7) "Key facilities" means:

(a) Airports;

(b) Major facilities of a public utility;

(c) Interchanges involving arterial highways;

(d) Rapid or mass transit terminals, stations, and fixed guideways.

(8) "Major facilities of a public utility" means:

(a) Central office buildings of telephone utilities;

(b) Transmission lines, power plants, and substations of electrical utilities; and

(c) Pipelines and storage areas of utilities providing natural gas or other petroleum derivatives.

(9) "Mass transit" means a coordinated system of transit modes providing transportation for use by the general public.

(10) "Mineral" means an inanimate constituent of the earth, in either solid, liquid, or gaseous state which, when extracted from the earth, is usable in its natural form or is capable of conversion into usable form as a metal, a metallic compound, a chemical, an energy source, a raw material for manufacturing, or construction material. This definition does not include surface or ground water subject to appropriation for domestic, agricultural, or industrial purposes, nor does it include geothermal resources.

(11) "Mineral resource area" means an area in which minerals are located in sufficient concentration in veins, deposits, bodies, beds, seams, fields, pools, or otherwise, as to be capable of economic recovery. The term includes but is not limited to any area in which there has been significant mining activity in the past, there is significant mining activity in the present, mining development is planned or in progress, or mineral rights are held by mineral patent or valid mining claim with the intention of mining.

(12) "Natural resources of statewide importance" is limited to shorelands of major publicly-owned reservoirs and significant wildlife habitats in which the wildlife species, as identified by the division of wildlife of the department of natural resources, in a proposed area could be endangered.

(13) "New communities" means the major revitalization of existing municipalities or the establishment of urbanized growth centers in unincorporated areas.

(14) "Rapid transit" means the element of a mass transit system involving a mechanical conveyance on an exclusive lane or guideway constructed solely for that purpose.

106-7-105. Effect of article - public utilities. (1) With regard to public utilities, nothing in this article shall be construed as enhancing or diminishing the power and authority of municipalities, counties, or the public utilities commission. Any order, rule, or directive issued by any governmental agency pursuant to this article shall not be inconsistent with or in contravention of any decision, order, or finding of the public utilities commission with respect to public convenience and necessity. The public utilities commission and public utilities shall take into consideration and, when feasible, foster compliance with adopted land use master plans of local governments, regions, and the state.

(2) Nothing in this article shall be construed as enhancing or diminishing the rights and procedures with respect to the power of a public utility to acquire property and rights-of-way by eminent domain to serve public need in the most economical and expedient manner.

106-7-106. Effect of article - rights of property owners - water rights. (1) Nothing in this article shall be construed as:

(a) Enhancing or diminishing the rights of owners of property as provided by the state constitution or the constitution of the United States;

(b) Modifying or amending existing laws or court decrees with respect to the determination and administration of water rights.

106-7-107. Effect of article - developments in areas of state interest and activities of state interest meeting certain conditions. (1) This article shall not apply to any development in an area of state interest or any activity of state interest which meets any one of the following conditions as of the effective date of this article:

(a) The development or activity is covered by a current building permit issued by the appropriate local government; or

(b) The development or activity has been approved by the electorate; or

(c) The development or activity is to be on land:

(I) Which has been conditionally or finally approved by the appropriate local government for planned unit development or for a use substantially the same as planned unit development; or

(II) Which has been zoned by the appropriate local government for the use contemplated by such development or activity; or

(III) With respect to which a development plan has been conditionally or finally approved by the appropriate governmental authority.

106-7-108. Effect of article - state agency or commission responses. (1) Whenever any person desiring to carry out development as defined in section 106-7-102 (1) is required to obtain a permit, to be issued by any state agency or commission for the purpose of authorizing or allowing such development, pursuant to this or any other statute or regulation promulgated thereunder, such agency shall establish a reasonable time period, which shall not exceed sixty days following receipt of such permit application, within which such agency must respond in writing to the applicant, granting or denying said permit or specifying all reasonable additional information necessary for the agency or commission to respond. If additional information is required, said agency or commission shall set a reasonable time period for response following the receipt of such information.

(2) Whenever a state agency or commission denies a permit, the denial must specify:

(a) The regulations, guidelines, and criteria or standards used in evaluating the application;

(b) The reasons for denial and the regulations, guidelines, and criteria or standards the application fails to satisfy; and

(c) The action that the applicant would have to take to satisfy the state agency's or commission's permit requirements.

(3) Whenever an application for a permit as provided under this section contains a statement describing the proposed nature, uses, and activities in conceptual terms for the development intended to be accomplished and is not accompanied with all additional information, including, without limitation, engineering studies, detailed plans and specifications, zoning approval, or where a hearing is required by the statutes, regulations, rules, ordinances, or resolutions thereof prior to the issuance of the requested permit, the agency or commission shall, within the time provided in this section for response, indicate its acceptance or denial of the permit on the basis of the concept expressed in the statement of the proposed uses and activities contained in the application. Such conceptual approval shall be made subject to the applicant filing and completing all prerequisite detailed additional information in accordance with the usual filing requirements of the agency or commission within a reasonable period of time.

(4) All agencies or commissions authorized or required to issue permits for development shall adopt rules and regulations, or amend existing rules and regulations, so as to require that such agency or commission respond in the time and manner required in this section.

(5) Nothing in this section shall shorten the time allowed for responses provided by federal statute dealing with, or having a bearing on, the subject of any such application for permit.

(6) The provisions of this section shall not apply to applications approved, denied, or processed by a unit of local

government.

PART 2

AREAS AND ACTIVITIES DESCRIBED - CRITERIA FOR ADMINISTRATION

106-7-201. Areas of state interest - as determined by local governments. (1) Subject to the procedures set forth in part 4 of this article, a local government may designate certain areas of state interest from among the following:

(a) Mineral resource areas;

(b) Natural hazard areas;

(c) Areas containing, or having a significant impact upon, historical, natural, or archaeological resources of statewide importance; and

(d) Areas around key facilities in which development may have a material effect upon the facility or the surrounding community.

106-7-202. Criteria for administration of areas of state interest. (1) (a) Mineral resource areas designated as areas of state interest shall be protected and administered in such a manner as to permit the extraction and exploration of minerals therefrom, unless extraction and exploration would cause significant danger to public health and safety. If the local government having jurisdiction, after weighing sufficient technical or other evidence, finds that the economic value of the minerals present therein is less than the value of another existing or requested use, such other use should be given preference; however, other uses which would not interfere with the extraction and exploration of minerals may be permitted in such areas of state interest.

(b) Areas containing only sand, gravel, quarry aggregate, or limestone used for construction purposes shall be administered as provided by article 36 of chapter 92, C.R.S. 1963.

(c) The extraction and exploration of minerals from any area shall be accomplished in a manner which causes the least practicable environmental disturbance, and surface areas disturbed thereby shall be reclaimed in accordance with the provisions of article 13 or article 32 of chapter 92, C.R.S. 1963, whichever is applicable.

(d) Unless an activity of state interest has been designated or identified or unless it includes part or all of another area of state interest, an area of oil and gas or geothermal resource development shall not be designated as an area of state interest unless the state oil and gas conservation commission identifies such area for designation.

(2) (a) Natural hazard areas shall be administered as follows:

(I) Floodplains shall be administered so as to minimize significant hazards to public health and safety or to property. The Colorado water conservation board shall promulgate a model floodplain regulation no later than September 30, 1974. Open space activities such as agriculture, recreation, and mineral extraction shall be encouraged in the floodplains. Any combination of these activities shall be conducted in a mutually compatible manner. Building of structures in the floodplain shall be designed in terms of the availability of flood protection devices, proposed intensity of use, effects on the acceleration of floodwaters, potential significant hazards to public health and safety or to property, and other impact of such development on downstream communities such as the creation of obstructions during floods. Activities shall be discouraged which, in time of flooding, would create significant hazards to public health and safety or to property. Shallow wells, solid waste disposal sites, and septic tanks and sewage disposal systems shall be protected from inundation by floodwaters. Unless an activity of state interest is to be conducted therein, an area of corrosive soil, expansive soil and rock, or siltation shall not be designated as an area of state interest unless the Colorado soil conservation board, through the local soil conservation district, identifies such area for designation.

(II) Wildfire hazard areas in which residential activity is to take place shall be administered so as to minimize significant hazards to public health and safety or to property. The Colorado state forest service shall promulgate a model wildfire hazard area control regulation no later than September 30, 1974. If development is to take place, roads shall be adequate for service by fire trucks and other safety equipment. Firebreaks and other means of reducing conditions conducive to fire shall be required for wildfire hazard areas in which development is authorized.

(III) In geologic hazard areas all developments shall be engineered and administered in a manner that will minimize significant hazards to public health and safety or to property due to a geologic hazard. The Colorado geological survey shall promulgate a model geologic hazard area control regulation no later than September 30, 1974.

(b) After promulgation of guidelines for land use in natural hazard areas by the Colorado water conservation board, the Colorado soil conservation board through the soil conservation districts, the Colorado state forest service, and the Colorado geological survey, natural hazard areas shall be administered by local government in a manner which is consistent with the guidelines for land use in each of the natural hazard areas.

(3) Areas containing, or having a significant impact upon, historical, natural, or archaeological resources of statewide importance, as determined by the state historical society, the department of natural resources, and the appropriate local government, shall be administered by the appropriate state agency in conjunction with the appropriate local government in a manner that will allow man to function in harmony with, rather than be destructive to, these resources. Consideration is to be given to the protection of those areas essential for wildlife habitat. Development in areas containing historical, archaeological, or natural resources shall be conducted in a manner which will minimize damage to those resources for future use.

(4) The following criteria shall be applicable to areas around key facilities:

(a) If the operation of a key facility may cause a danger to public health and safety or to property, as determined by local government, the area around the key facility shall be designated and administered so as to minimize such danger; and

(b) Areas around key facilities shall be developed in a manner that will discourage traffic congestion, incompatible uses, and expansion of the demand for government services beyond the reasonable capacity of the community or region to provide such services as determined by local government. Compatibility with nonmotorized traffic shall be encouraged. A development that imposes burdens or deprivation on the communities of a region cannot be justified on the basis of local benefit alone.

(5) In addition to the criteria described in subsection (4) of this section, the following criteria shall be applicable to areas around particular key facilities:

(a) Areas around airports shall be administered so as to:

(I) Encourage land use patterns for housing and other local government needs that will separate uncontrollable noise sources from residential and other noise-sensitive areas; and

(II) Avoid danger to public safety and health or to property due to aircraft crashes.

(b) Areas around major facilities of a public utility shall be administered so as to:

(I) Minimize disruption of the service provided by the public utility; and

(II) Preserve desirable existing community patterns.

(c) Areas around interchanges involving arterial highways shall be administered so as to:

(I) Encourage the smooth flow of motorized and nonmotorized traffic;

(II) Foster the development of such areas in a manner calculated to preserve the smooth flow of such traffic; and

(III) Preserve desirable existing community patterns.

(d) Areas around rapid or mass transit terminals, stations, or guideways shall be developed in conformance with the applicable municipal master plan adopted pursuant to section 139-59-6, C.R.S. 1963, or any applicable master plan adopted pursuant to section 106-2-7. If no such master plan has been adopted, such areas shall be developed in a manner designed to minimize congestion in the streets; to secure safety from fire, flood waters, and other dangers; to promote health and general welfare; to provide adequate light and air; to prevent the overcrowding of land; to avoid undue concentration of population; to facilitate the adequate provision of transportation, water, sewerage, schools, parks, and other public requirements. Such development in such areas shall be made with reasonable consideration, among other things, as to the character of the area and its peculiar suitability for particular uses, and with a view to conserving the value of buildings and encouraging the most appropriate use of land throughout the jurisdiction of the applicable local government.

106-7-203. Activities of state interest as determined by local governments. (1) Subject to the procedures set forth in part 4 of this article, a local government may designate certain activities of state interest from among the following:

(a) Site selection and construction of major new domestic water and sewage treatment systems and major extension of existing domestic water and sewage treatment systems;

(b) Site selection and development of solid waste disposal sites;

(c) Site selection of airports;

(d) Site selection of rapid or mass transit terminals, stations, and fixed guideways;

(e) Site selection of arterial highways and interchanges and collector highways;

(f) Site selection and construction of major facilities of a public utility;

(g) Site selection and development of new communities;

(h) Efficient utilization of municipal and industrial water projects; and

(i) Conduct of nuclear detonations.

106-7-204. Criteria for administration of activities of state interest. (1) (a) New domestic water and sewage treatment systems shall be constructed in areas which will result in the proper utilization of existing treatment plants and the orderly development of domestic water and sewage treatment systems of adjacent communities.

(b) Major extensions of domestic water and sewage treatment systems shall be permitted in those areas in which the anticipated growth and development that may occur as a result of such extension can be accommodated within the financial and environmental capacity of the area to sustain such growth and development.

(2) Major solid waste disposal sites shall be developed in accordance with sound conservation practices and shall emphasize, where feasible, the recycling of waste materials. Consideration shall be given to longevity and subsequent use of waste disposal sites, soil and wind conditions, the potential problems of pollution inherent in the proposed site, and the impact on adjacent property owners, compared with alternate locations.

(3) Airports shall be located or expanded in a manner which will minimize disruption to the environment of existing communities, will minimize the impact on existing community services, and will complement the economic and transportation needs of the state and the area.

(4) (a) Rapid or mass transit terminals, stations, or guideways shall be located in conformance with the applicable municipal master plan adopted pursuant to section 139-59-6, C.R.S. 1963, or any applicable master plan adopted pursuant to section 106-2-7. If no such master plan has been adopted, such areas shall be developed in a manner designed to minimize congestion in the streets; to secure safety from fire, flood waters, and other dangers; to promote health and general welfare; to provide adequate light and air; to prevent the overcrowding of land; to avoid undue concentration of population; to facilitate the adequate provision of transportation, water, sewerage, schools, parks, and other public requirements. Activities shall be conducted with reasonable consideration, among other things, as to the character of the area and its peculiar suitability for particular uses, and with a view to conserving the value of buildings and encouraging the most appropriate use of land

throughout the jurisdiction of the applicable local government.

(b) Proposed locations of rapid or mass transit terminals, stations, and fixed guideways which will not require the demolition of residences or businesses shall be given preferred consideration over competing alternatives.

(c) A proposed location of a rapid or mass transit terminal, station, or fixed guideway that imposes a burden or deprivation on a local government cannot be justified on the basis of local benefit alone, nor shall a permit for such a location be denied solely because the location places a burden or deprivation on one local government.

(5) Arterial highways and interchanges and collector highways shall be located so that:

(a) Community traffic needs are met;

(b) Desirable community patterns are not disrupted; and

(c) Direct conflicts with adopted local government, regional, and state master plans are avoided.

(6) Where feasible, major facilities of public utilities shall be located so as to avoid direct conflict with adopted local government, regional, and state master plans.

(7) When applicable, or as may otherwise be provided by law, a new community design shall, at a minimum, provide for transportation, waste disposal, schools, and other governmental services in a manner that will not overload facilities of existing communities of the region. Priority shall be given to the development of total communities which provide for commercial and industrial activity, as well as residences, and for internal transportation and circulation patterns.

(8) Municipal and industrial water projects shall emphasize the most efficient use of water, including, to the extent permissible under existing law, the recycling and reuse of water. Urban development, population densities, and site layout and design of storm water and sanitation systems shall be accomplished in a manner that will prevent the pollution of aquifer recharge areas.

(9) Nuclear detonations shall be conducted so as to present no material danger to public health and safety. Any danger to property shall not be disproportionate to the benefits to be derived from a detonation.

PART 3

LEVELS OF GOVERNMENT INVOLVED AND THEIR FUNCTIONS

106-7-301. Functions of local government. (1) Pursuant to this article, it is the function of local government to:

(a) Designate matters of state interest after public hearing, taking into consideration:

(I) The intensity of current and foreseeable development pressures; and

(II) Applicable guidelines for designation issued by the applicable state agencies;

(b) Hold hearings on applications for permits for development in areas of state interest and for activities of state interest;

(c) Grant or deny applications for permits for development in areas of state interest and for activities of state interest;

(d) Receive recommendations from state agencies and other local governments relating to matters of state interest;

(e) Send recommendations to other local governments and the Colorado land use commission relating to matters of state interest; and

(f) Act, upon request of the Colorado land use commission, with regard to specific matters of state interest.

106-7-302. Functions of other state agencies. (1) Pursuant to this article, it is the function of other state agencies to:

(a) Send recommendations to local governments and the Colorado land use commission relating to designation of matters of state interest on the basis of current and developing information; and

(b) Provide technical assistance to local governments concerning designation of and guidelines for matters of state interest.

(2) Primary responsibility for the recommendation and provision of technical assistance functions described in subsection (1) of this section is upon:

(a) The Colorado water conservation board, acting in cooperation with the Colorado soil conservation board, with regard to floodplains;

(b) The Colorado state forest service, with regard to wildfire hazard areas;

(c) The Colorado geological survey, with regard to geologic hazard areas, geologic reports, and the identification of mineral resource areas;

(d) The Colorado division of mines, with regard to mineral extraction and the reclamation of land disturbed thereby;

(e) The Colorado soil conservation board and soil conservation districts, with regard to resource data inventories, soils, soil suitability, erosion and sedimentation, floodwater problems, and watershed protection; and

(f) The division of wildlife of the department of natural resources, with regard to significant wildlife habitats.

(3) Pursuant to section 106-7-202 (1) (d), the oil and gas conservation commission of the state of Colorado may identify an area of oil and gas development for designation by local government as an area of state interest.

PART 4

DESIGNATION OF MATTERS OF STATE INTEREST - GUIDELINES FOR ADMINISTRATION

106-7-401. Designation of matters of state interest. (1) After public hearing, a local government may designate matters of state interest within its jurisdiction, taking into consideration:

(a) The intensity of current and foreseeable development pressures; and

(b) Applicable guidelines for designation issued by the Colorado land use commission after recommendation from other state agencies, if appropriate. In adopting such guidelines, the Colorado land use commission shall be guided by the standards set forth in this article applicable to local governments.

(2) A designation shall:

(a) Specify the boundaries of the proposed area; and

(b) State reasons why the particular area or activity is of state interest, the dangers that would result from uncontrolled development of any such area or uncontrolled conduct of such activity, and the advantages of development of such area or conduct of such activity in a coordinated manner.

106-7-402. Guidelines - regulations. (1) The local government shall develop guidelines for administration of the designated matters of state interest. The content of such guidelines shall be such as to facilitate administration of matters of state interest consistent with sections 106-7-202 and 106-7-204.

(2) A local government may adopt regulations interpreting and applying its adopted guidelines in relation to specific developments in areas of state interest and to specific activities of state interest.

(3) No provision in this article shall be construed as prohibiting a local government from adopting guidelines or regulations containing requirements which are more stringent than the requirements of the criteria listed in sections 106-7-202 and 106-7-204.

106-7-403. Technical and financial assistance. (1) Appropriate state agencies shall provide technical assistance to local governments in order to assist local governments in designating matters of state interest and adopting guidelines for the administration thereof.

(2) (a) The department of local affairs shall oversee and coordinate the provision of technical assistance and provide financial assistance as may be authorized by law.

(b) The department of local affairs shall determine whether technical or financial assistance or both are to be given to a local government on the basis of the local government's:

(I) Showing that current or reasonably foreseeable development pressures exist within the local government's jurisdiction; and

(II) Plan describing the proposed use of technical assistance and expenditure of financial assistance.

106-7-404. Public hearing - designation of an area or activity of state interest and adoption of guidelines by order of local government. (1) The local government shall hold a public hearing before designating an area or activity of state interest and adopting guidelines for administration thereof.

(2) (a) Notice, stating the time and place of the hearing and the place at which materials relating to the matter to be designated and guidelines may be examined, shall be published once at least thirty and not more than sixty days before the public hearing in a newspaper of general circulation in the county. The local government shall send written notice to the Colorado land use commission of a public hearing to be held for the purpose of designation and adoption of guidelines at least

thirty days and not more than sixty days before such hearing.

(b) Any person may request, in writing, that his name and address be placed on a mailing list to receive notice of all hearings held pursuant to this section. If the local government decides to maintain such a mailing list, it shall mail notices to each person paying an annual fee reasonably related to the cost of production, handling, and mailing such notice. In order to have his name and address retained on said mailing list, the person shall resubmit his name and address and pay such fee before January 31 of each year.

(3) Within thirty days after completion of the public hearing, the local government, by order, may adopt, adopt with modification, or reject the particular designation and guidelines; but the local government, in any case, shall have the duty to designate any matter which has been finally determined to be a matter of state interest and adopt guidelines for the administration thereof.

(4) After a matter of state interest is designated pursuant to this section, no person shall engage in development in such area and no such activity shall be conducted until the designation and guidelines for such area or activity are finally determined pursuant to this article.

(5) Upon adoption by order, all relevant materials relating to the designation and guidelines shall be forwarded to the Colorado land use commission for review.

106-7-405. Report of local government's progress. (1) Not later than one hundred eighty days after the effective date of this article, each local government shall report to the Colorado land use commission, on a form to be furnished by the Colorado land use commission, the progress made toward designation and adoption of guidelines for administration of matters of state interest.

(2) Upon the basis of the information contained in such reports and any information received pursuant to any other relevant provision of this article, the Colorado land use commission may take appropriate action pursuant to section 106-4-3(2)(a).

106-7-406. Colorado land use commission review of local government order containing designation and guidelines. (1) Not later than thirty days after receipt of a local government order designating a matter of state interest and adopting guidelines for the administration thereof, the Colorado land use commission shall review the contents of such order on the basis of the relevant provisions of part 2 of this article and shall accept the designation and guidelines or recommend modification thereof.

(2) If the Colorado land use commission decides that modification of the designation or guidelines is required, the Colorado land use commission shall, within said thirty-day period, submit to the local government written notification of its recommendations and shall specify in writing the modifications which the Colorado land use commission deems necessary for compliance with the relevant provisions of part 2 of this article.

(3) Not later than thirty days after receipt of the modifications recommended by the Colorado land use commission, a local government shall:

(a) Modify the original order in a manner consistent with the recommendations of the Colorado land use commission and resubmit the order to the Colorado land use commission; or

(b) Notify the Colorado land use commission that the Colorado land use commission's recommendations are rejected.

106-7-407. Colorado land use commission may initiate identification, designation, and promulgation of guidelines for matters of state interest. (1) (a) The Colorado land use commission may submit a formal request to a local government to take action with regard to a specific matter which said commission considers to be of state interest within the local government's jurisdiction. Such request shall identify the specific matter and shall set forth the information required in section 106-7-401 (2) (a) and (2) (b). Not later than thirty days after receipt of such request, the local government shall publish notice and hold a hearing within sixty days pursuant to the provisions of section 106-7-404, and issue its order thereunder.

(b) After receipt by a local government of a request from the Colorado land use commission pursuant to paragraph (a) of this subsection (1), no person shall engage in development in the area or conduct the activity specifically described in said request until the local government has held its hearing and issued its order relating thereto.

(c) If the local government's order fails to designate such matter and adopt guidelines therefor, or, after designation, fails to adopt guidelines therefor pursuant to standards set forth in this article applicable to local governments, the Colorado land use commission may seek judicial review of such order or guidelines by a trial de novo in the district court for the judicial district in which the local government is located. During the pendency of such court proceedings, no person shall engage in development in the area or conduct the activity specifically described in said request except on such terms and conditions as authorized by the court.

PART 5

PERMITS FOR DEVELOPMENT IN AREAS OF STATE INTEREST AND FOR CONDUCT OF ACTIVITIES OF STATE INTEREST

106-7-501. Permit for development in area of state interest or for conduct of an activity of state interest required. (1) (a) Any person desiring to engage in development in an area of state interest or to conduct an activity of state interest shall file an application for a permit with the local government in which such development or activity is to take place. The application shall be filed on a form prescribed by the Colorado land use commission. A reasonable fee determined by the local government sufficient to cover the cost of processing the application, including the cost of holding the necessary hearings, shall be paid at the time of filing such application.

(b) The requirement of paragraph (a) of this subsection (1) that a public utility obtain a permit shall not be deemed to waive the requirements of article 5 of chapter 115, C.R.S. 1963, that a public utility obtain a certificate of public convenience and necessity.

(2) (a) Not later than thirty days after receipt of an application for a permit, the local government shall publish notice of a hearing on said application. Such notice shall be published once in a newspaper of general circulation in the county, not less than thirty nor more than sixty days before the date set for hearing, and shall be given to the Colorado land use commission. The Colorado land use commission may give notice to such other persons as it determines not later than fourteen days before such hearing.

(b) If a person proposes to engage in development in an area of state interest or for conduct of an activity of state interest not previously designated and for which guidelines have not been adopted, the local government may hold one hearing for determination of designation and guidelines and granting or denying the permit.

(c) The local government may maintain a mailing list and send notice of hearings relating to permits in a manner similar to that described in section 106-7-404 (2) (b).

(3) The local government may approve an application for a permit to engage in development in an area of state interest if the proposed development complies with the local government's guidelines and regulations governing such area. If the proposed development does not comply with the guidelines and regulations, the permit shall be denied.

(4) The local government may approve an application for a

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permit for conduct of an activity of state interest if the proposed activity complies with the local government's regulations and guidelines for conduct of such activity. If the proposed activity does not comply with the guidelines and regulations, the permit shall be denied.

(5) The local government conducting a hearing pursuant to this section shall:

(a) State, in writing, reasons for its decision, and its findings and conclusions; and

(b) Preserve a record of such proceedings.

(6) After the effective date of this article, any person desiring to engage in a development in a designated area of state interest or to conduct a designated activity of state interest who does not obtain a permit pursuant to this section may be enjoined by the Colorado land use commission or the appropriate local government from engaging in such development or conducting such activity.

106-7-502. Judicial review. The denial of a permit by a local government agency shall be subject to judicial review in the district court for the judicial district in which the major development or activity is to occur.

SECTION 2. Article 3 of chapter 106, Colorado Revised Statutes 1963, as amended, is amended BY THE ADDITION OF A NEW SECTION to read:

106-3-9. Statewide program for identification of matters of state interest as part of local land use planning. (1) The department of local affairs shall conduct a statewide program encouraging counties and municipalities to prepare, as a part of the comprehensive plan provided for in section 106-2-5 and article 59 of chapter 139, C.R.S. 1963, a complete and detailed identification and designation of all matters of state interest within each county by June 30, 1976. The general assembly shall appropriate funds for this purpose to the department of local affairs for distribution to participating counties. Each county desiring to participate in the identification and designation of matters of state interest program established by this section shall be allocated an equal amount by the department of local affairs from the funds so appropriated, to be expended by each county separately or through an organized group of counties or counties and municipalities. The department of local affairs, in cooperation with applicable state agencies, shall establish reasonable standards relative to the scope, detail, and accuracy of the program and shall insure that all information is comparable for each county. Each county shall, after consultation with the municipality, prepare such identification and designation for territory located within these municipalities which request such preparation and in any municipality which fails to undertake an identification and designation program. Each county shall, upon request of the municipality, assist the municipality in its identification and designation program.

(2) The general assembly shall appropriate to the department of local affairs funds to assist counties and municipalities participating in the identification and designation of matters of state interest program, where additional assistance is deemed by the department of local affairs to be necessary. The department of local affairs shall also allocate such funds upon request of any county participating in the identification and designation of matters of state interest program under subsection (1) of this section for implementation of supplemental planning in that county, or to any municipality, based upon priorities established by the department of local affairs and on the need and capabilities of each county and municipality.

SECTION 3. 106-4-3 (2) (a), Colorado Revised Statutes 1963 (1971 Supp.), is amended to read:

106-4-3. Duties of the commission - temporary emergency power. (2) (a) Whenever in the normal course of its duties as set forth in this article the commission determines that there is in progress or proposed a land development activity which constitutes a danger of irreparable injury, loss, or damage of serious and major proportions to the public health, welfare, or safety, the commission shall immediately give written notice to the board of county commissioners of each county involved of the pertinent facts and dangers with respect to such activity. If the said board of county commissioners does not remedy the situation within a reasonable time, the commission may request the governor to review such facts and dangers with respect to such activity. If the governor grants such request, such review shall be conducted by the governor at a meeting with the commission and the boards of county commissioners of the counties involved. If, after such review, the governor shall determine that such activity does constitute such a danger, the governor may direct the commission to issue its written cease and desist order to the person in control of such activity. Such order shall require that such person immediately discontinue such activity. If such activity, notwithstanding such order, is continued, the commission may apply to any district court of this state in which such activity is located for a temporary restraining order, preliminary injunction, or permanent injunction, as provided for in the Colorado rules of civil procedure. Any such action shall be given precedence over all other matters pending in such district court. The institution of such action shall confer upon said district court exclusive jurisdiction to determine finally the subject matter thereof.

SECTION 4. Article 4 of chapter 106, Colorado Revised

Statutes 1963, as amended, is amended BY THE ADDITION OF A NEW SECTION to read:

106-4-5. Commission staff to assist counties and municipalities. The commission, within available appropriations, shall assign full-time professional staff members to assist counties and municipalities in the program established under article 7 of this chapter and to monitor progress in the same. No later than February 1, 1975, the commission shall issue its report to the general assembly as to progress being made in such program and shall include in its report those items required by section 106-4-4 (4) (b) and (4) (c).

SECTION 5. Appropriation. (1) There is hereby appropriated to the department of local affairs, out of any moneys in the state treasury not otherwise appropriated, the sum of two million seventy-five thousand dollars ($2,075,000), or so much thereof as may be necessary, to implement the provisions of section 106-3-9, C.R.S. 1963, which moneys shall become available upon passage of this act and remain available until June 30, 1975, to be allocated as follows: Identification and designation of matters of state interest program - one million five hundred seventy-five thousand dollars ($1,575,000); supplemental planning - five hundred thousand dollars ($500,000).

(2) There is hereby appropriated out of any moneys in the state treasury not otherwise appropriated, to the Colorado land use commission, for the fiscal year beginning July 1, 1974, the sum of three hundred thousand dollars ($300,000), or so much thereof as may be necessary, to provide assistance to counties and municipalities pursuant to section 106-4-5, C.R.S. 1963 (10.0 FTE, five of which shall be full-time professional staff pursuant to said section 106-4-5).

SECTION 6. Safety clause. The general assembly hereby finds, determines, and declares that this act is necessary for the immediate preservation of the public peace, health, and safety.

John D. Fuhr
SPEAKER OF THE HOUSE
OF REPRESENTATIVES

Ted L. Strickland
ACTING PRESIDENT
OF THE SENATE

Lorraine F. Lombardi
CHIEF CLERK OF THE HOUSE
OF REPRESENTATIVES

Comfort W. Shaw
SECRETARY OF
THE SENATE

APPROVED ____________________

John D. Vanderhoof
GOVERNOR OF THE STATE OF COLORADO

APPENDIX E

COLORADO EMISSION CONTROL REGULATIONS AND AMBIENT AIR QUALITY STANDARDS - AS AMENDED

COMMON PROVISIONS REGULATION

Definitions, Statement of Intent and General Provisions applicable to all emission control regulations adopted by the Colorado Air Pollution Control Commission.

APPLICABILITY:

Emission control regulations adopted by the Commission apply throughout Colorado unless otherwise stipulated. The statement of intent, definitions, and general provisions of this regulation apply to all emission control regulations adopted by the Commission unless otherwise stipulated.

AUTHORITY:

Section 66-31-8 of the Colorado Air Pollution Control Act of 1970 provides: "As promptly as possible, the Commission shall adopt and promulgate emission control regulations which require the use of effective practical air pollution controls for each and every significant source, potential source, and type of source of air contamination throughout the entire State and thereafter may modify such regulations from time to time." Sections 66-31-4, 66-31-6 and 66-31-8 of the Act are the general statutory authority for adoption by the Air Pollution Control Commission of standards and the specific section of the Act is cited in each instance.

STATE OF COLORADO AIR POLLUTION CONTROL ACT (1970) LEGISLATIVE DECLARATION (66-31-2)

In order to foster the health, welfare, convenience, and comfort of the inhabitants of the State of Colorado, and to facilitate the enjoyment of nature, scenery, and other resources of the State, it is hereby declared to be the policy of the State to achieve the maximum practical degree of air purity in every portion of the State. To that end, it is the purpose of this article to require the use of all available practical methods to reduce, prevent, and control air pollution throughout the entire State of Colorado, and to maintain a cooperative program between the State and local units of government. It is further declared that the prevention, abatement, and control of air pollution in each portion of the entire State are matters of statewide concern and are effected with a public interest and that the provisions of this article are enacted in the exercise of the police powers of this State for the purpose of protecting the health, peace, safety, and general welfare of the people of this State.

INTENT:

To implement the legislative declaration and other sections of the Act, the Commission declares that it is the intent and purpose of these regulations:

1. To achieve and maintain levels of air quality which will protect human health and safety, prevent injury to plant and animal life, prevent damage to property, prevent unreasonable interference with the public welfare, preserve visibility and protect scenic, aesthetic and historic values of Colorado,

2. To require the use of all available practical methods to reduce, prevent, and control air pollution for the protection of the health, safety, and general welfare of the people of the state of Colorado. In order to achieve air purity consistent with this intent it is necessary, ultimately to control air contaminant emissions to such a degree of opacity so that the emissions are no longer visible,

3. To prevent significant degradation of Colorado's air resource,

4. To prevent odors and other air pollution problems which interfere with the comfortable enjoyment of life, and

5. To apply the major resources of the Colorado air pollution control programs toward solving priority air pollution problems.

The Commission recognizes that the growth in the amount and complexity of air pollution in Colorado is brought about by and incident to population growth, mobility, increased affluence, industrial development and changing social values in said State. The Commission believes that the air pollution problem is likely to be aggravated and compounded by additional population growth, mobility, affluence, industrial development, and changing social values in the future, which are likely to result in serious potential danger to the public and the environment. Therefore, the Commission intends to pursue solutions, in conjunction with other appropriate agencies and interests, which have a direct interest and capability in solving a growing air pollution problem in relation to the broader environmental degradation problem. It is the intent of the Commission to coordinate with industrial, commercial, agricultural and transportation planning organizations, land use and other environmental organizations, the public, the legislature, educational organizations, and other major interests in such a manner as to prevent air pollution in Colorado.

I. DEFINITIONS:

The following words and phrases have the following meanings unless the context in which they are used requires otherwise:

ACT	the Colorado Air Pollution Control Act of 1970, Chapter 64, Colorado Session laws 1970.
AIR CONTAMINANT	any fume, smoke, particulate matter, vapor, gas, or any combination thereof, but not including water vapor or steam condensate.
AIR CONTAMINATION SOURCE	any source whatsoever at, from, or by reason of which there is emitted or discharged into the atmosphere any air contaminant.
AIR CONTAMINATION SOURCE (existing)	Any air contamination source, which has been constructed or for which there is a binding agreement or contract providing for its construction or modification to be completed within a reasonable time after the effective date of the regulation in question.
AIR CONTAMINATION SOURCE (new)	Any air contamination source which is to be constructed or modified and which is other than an existing air contamination source.
AIR POLLUTION	any concentration of one or more air contaminants in the outdoor atmosphere as has caused, is causing, or if unabated may cause injury to human, plant, or animal life, or injury to property, or which unreasonably interferes with the comfortable enjoyment of life or property or with the conduct of business
AIR POLLUTION CONTROL AUTHORITY	the Division, or any person or agency given authority by the Division, or a local governmental unit duly authorized with respect to air pollution control.
AMBIENT AIR	is the surrounding outside air.

MOSPHERE	means the air that envelops or surrounds the earth. For the purpose of this regulation emissions of air contaminants from a building or structure not specifically designed to control air pollution originating from an air contamination source or sources within such building or structure shall constitute an emission to the atmosphere.
COMMISSION	the Colorado Air Pollution Control Commission created by Section 66-31-4 of the Act.
DEPARTMENT	The Colorado Department of Health.
DIVISION	the Division of Air Pollution Control, Colorado Department of Health.
DUSTS	minute solid particles released into the air by natural forces or by mechanical processes such as crushing, grinding, milling, drilling, demolishing, shoveling, conveying, covering, bagging, sweeping, etc.
EMISSION	the discharge or release into the atmosphere of one or more air contaminants.
EMISSION CONTROL REGULATION	any standard promulgated by regulation which is applicable to all air contamination sources within a specified area and which prohibits or establishes permissible limits for specific types of emissions in such area, and also any regulation which by its terms is applicable to a specified type of facility, process, or activity for the purpose of controlling the extent, degree, or nature of contamination emitted from such type of facility, process, or activity, and also any regulation adopted for the purpose of preventing or minimizing emission of any air contaminant in potentially dangerous quantities.
FUEL BURNING EQUIPMENT	any furnace, boiler apparatus, stack, or appurtenances thereto used in the process of burning fuel for the primary purpose of producing heat or power by indirect heat transfer.
FUGITIVE DUST	solid airborne particulate matter emitted from any source other than an opening which channels the flow or air contaminants and

then exhausts the contaminants directly into the atmosphere. Fugitive dust also includes solid particles released into the atmosphere by natural forces or by mechanical processes such as crushing, grinding, milling, drilling, demolishing, shoveling, conveying, covering, bagging, sweeping, etc.

INCINERATORS

Incinerator	any equipment, device, or contrivance used for the destruction of garbage, rubbish, or other wastes by burning, but not wood wastes burned in devices commonly called wigwam waste burners.
Approvable Incinerator (Effective May 1, 1973)	any incinerator which is constructed and is operated so as to meet all the regulations of the Commission pertaining to incinerators.
Multiple Chamber Incinerator	any article, machine, equipment, contrivance, structure, or part of a structure used to dispose of combustible refuse by burning, consisting of three or more refractory-lined combustion furnaces in series, physically separated by refractory walls, inter-connected by gas passage ports or ducts, and employing adequate design parameters necessary for maximum combustion of the material to be burned.

LAND DEVELOPER	Any person, firm, corporation or governmental entity who initiates any change in the state of existing land use. The person, firm, corporation or governmental entity who contracts with others for construction services for said change in land use will be deemed to be the land developer.

MODIFICATIONS	1. The construction or installation on the premises of new equipment; 2. The replacement or alteration of equipment in such a manner as to either increase or decrease the production or control of air contamination excluding routine adjustments or maintenance; and 3. the moving of equipment to another premise.
OPACITY	the degree to which an air contaminant emission obscures the view of an observer, expressed in percentage of the obscuration, or in the degree (percent) to which transmittance of light is reduced by an air contaminant emission.
OPEN BURNING	fire, where any material is burned in the open or in a receptacle other than a furnace, incinerator, or other equipment connected to a stack or chimney.
OPENING	any single chimney, conduit, duct, smokestack, flue or other contrivance from which air contaminants are exhausted into the atmosphere.
PARTICULATE MATTER	any material, except uncombined water, that exists in a finely divided form as a liquid or solid.
PERSON	any individual, public or private corporation, partnership, association, firm, trust estate, the State or any department, institution, or agency thereof, any municipal corporation, county, city and county, or other political subdivision of the State, or any other legal entity whatsoever which is recognized by law as the subject of rights and duties.
PROCESS OR PROCESS EQUIPMENT	any action, operation, or treatment, involving chemical, industrial, or manufacturing factors, such as heat-treating furnaces, by-product coke plants, coke-baking ovens, mixing kettles, cupulas,

	blast furnaces, open hearth furnaces, heating and reheating furnaces, puddling furnaces, sintering plants, Bessemer converters, electric steel furnaces, ferrous and non-ferrous foundries, kilns, stills, dryers, roasters, and equipment used in connection therewith, and all other methods or forms of manufacturing or processing that may emit air contamination.
PROCESS UNIT	any single process or process equipment
PROCESS WEIGHT	the total weight of all materials introduced into a source operation, which source causes any discharge of air contaminants into the atmosphere. Solid fuels introduced into any specific source will be considered as part of the process weight, but liquid and gaseous fuels and combustion air will not.
PROCESS WEIGHT RATE	a rate established as follows: (a) for continuous source operations, the total process weight for the entire period of continuous operation or for a typical portion thereof, divided by the number of hours of such period or portion thereof, or (b) for cyclical or batch unit operations, or unit processes, the total process weight for a period that covers a complete operation or an integral number of cycles, divided by the hours of actual process operation during such a period, or (c) for operations, not specified above, determine the process weight that results in a minimum value for allowable emissions.
SMOKE	small gas-borne particles resulting from incomplete combustion, consisting predominantly, but not exclusively of carbon, and other combustible material.
STACK OR CHIMNEY	any vertical flue, conduit, or duct arranged to conduct an effluent to the open air.

STANDARD CONDITIONS	a gas temperature of 68 degrees Fahrenheit and a gas pressure of 29.92 inches of mercury.
UPSET CONDITIONS	an unpredictable equipment failure or other malfunction which results in the violation of emission control regulation, and which is not due to improper or careless operation.
WIGWAM WASTE BURNER (Effective: May 1, 1973)	any burner which consists of a single combustion chamber, has the general features of a truncated cone, and is used for incineration of wood wastes.

II. GENERAL:

A. TO CONTROL EMISSIONS LEAVING COLORADO:

"When emissions generated from sources in Colorado cross the state boundary line, such emissions shall not cause the air quality standards of the receiving state to be exceeded provided reciprocal action is taken by the receiving state." (66-31-21(3)).

B. EMISSION MONITORING REQUIREMENTS:

The Division may require owners or operators of stationary air contamination sources to install, maintain, and use instrumentation to monitor and record emission data as a basis for periodic reports to the Division. (66-31-6, 66-31-10(2)(c) and (d)).

C. PERFORMANCE TESTING:

In order to determine compliance with emission control regulations, the Division may require the owner or operator of any source to conduct performance tests in accordance with methods approved by the Division with the tests being made at the expense of the owner or operator. The Division may monitor such required performance tests conducted by the owner or operator and may also conduct performance tests. (66-31-6, 66-31-10(2)(c) and (d)).

D. UPSET CONDITIONS AND BREAKDOWNS:

Upset conditions, as defined, shall not be deemed to be in violation of these Regulations provided that the Air Pollution Control Division is notified as soon as possible, but no later than 2 hours after the start of the next working day, followed by written notice to the Division explaining the cause of the occurrence and that proper action has been or is being taken to correct the conditions causing said violation and to prevent such excess emissions in the future. (66-31-8(4)).

E. EFFECTIVE DATE:

The effective date of this "common provisions regulation" is February 1, 1972.

F. REVOCATION OF TEMPORARY EMISSION CONTROL REGULATIONS:

The temporary emission control regulations, identical to provisions set forth in sections 66-29-5(2) through (6), Colorado revised statutes 1963, as amended, are revoked. (66-31-24(1)).

G. CONFLICTS:

Nothing in these regulations is intended to permit any practice which is a violation of any statute, ordinance or regulation. (66-31-6).

H. SEVERABILITY CLAUSE:

If any Regulation, Section, clause, phrase, or standard contained in these regulations shall for any reason be held to be inoperative, unconstitutional, void or invalid, the validity of the remaining portions thereof shall not be affected thereby and the Commission does hereby declare that it severally passed and adopted the provisions contained therein separately and apart from the other provisions thereof. (66-31-6).

I. CIRCUMVENTION CLAUSE:

A person shall not build, erect, install, or use any article, machine, equipment, condition, or any contrivance, the use of which, without resulting in a reduction in the total release of air contaminants to the atmosphere, reduces or conceals an emission which would otherwise constitute a violation of this Regulation. No person shall circumvent this Regulation by using more openings than is considered normal practice by the industry or activity in question. (Sections 66-31-8(1)(a) and (b), and 66-31-8(3)(a)).

J. COMPLIANCE PLAN INCREMENTS OF PROGRESS:

Any hearing request made in accordance with 66-31-13(4)(a)(iii) or (iv), or compliance plan that is received by the Division, Variance Board or Commission, pursuant to any Commission Air Quality Control Regulation or State Implementation Plan requirement shall contain the following Increments of Progress:

1. Date of submittal of the source's final control plan to the appropriate air pollution control agency;
2. Date by which contracts for emission control systems or process modifications will be awarded; or date by which orders will be issued for the purchase of component parts to accomplish emission control or process modification;
3. Date of initiation of on-site construction or installation of emission control equipment or process changes;
4. Date by which on-site construction or installation of emission control equipment or process modification is to be completed; and
5. Date by which final compliance is to be achieved.

Exceptions:

Sources that are solely indirect sources of air pollution.

REGULATION NO. 1

(Amended)

Emission Control Regulations for Particulates, Smokes, and Sulfur Oxides for the State of Colorado

Colorado Air Pollution Control Commission

Adopted : December 9, 1971
Effective Date: February 1, 1972

REGULATION NO. 1
(Amended)

Emission Control Regulations for Particulates, Smokes, and Sulfur Oxides for the State of Colorado

I. SMOKE EMISSIONS AND OPACITY REGULATIONS:

A. Stationary Air Contamination Sources:

1. No person shall emit or cause to be emitted into the atmosphere, from any air contamination source of emission whatsoever, any air contaminant which is of such a shade or density as to obscure an observer's vision to a degree in excess of 20% opacity. Instrumentation which results in equivalent readings may be used in specific installations if approved in advance by the Air Pollution Control Division. (66-31-8(2) (a) and (b).

2. Exceptions:

   a. No person shall emit or cause to be emitted into the atmosphere from any alfalfa dehydrating mill, any air contaminant for a period or periods aggregating more than three minutes in any 60 consecutive minutes which is of such a shade or density as to obscure an observer's·vision to a degree in excess of 40% opacity. This emission standard for alfalfa dehydrating mills shall be in effect up to and including one year from the effective date of the Smoke Emissions and Opacity Regulations (Part I, Section A); thereafter, the 20% opacity limitation provided in Part I Section A shall apply to emissions from alfalfa dehydrating mills. (66-31-8(3)(a) and (f)).

   b. No person shall emit or cause to be emitted into the atmosphere from any pilot plant and experimental operation any air contaminant for a period or periods aggregating more than three minutes in any 60 consecutive minutes which is of such a shade or density as to obscure an observer's vision to a degree in excess of 40% opacity. This emission standard for pilot plants and experimental operations shall be in effect for a period not to exceed 180 operating days, cumulative total, from the date such operations commence; thereafter, the 20% opacity limitation provided in Part I Section A of these regulations shall apply to emissions from pilot plants and experimental operations. (66-31-8(1)(a)(e) and (f)).

c. Emissions from fireplaces used for non-commercial or recreational purposes shall be exempt from Part I Section A.1 of these regulations. (66-31-8(1)(a)(d)(e) and (f)).

d. Provisions of I.A.1 shall not apply to emissions during the building of a new fire, cleaning of fires, soot blowing, start-up, any process modification or adjustment, or occasional cleaning of control equipment, the shade or appearance of which is not darker than an equivalent opacity as to obscure an observer's view to a degree not greater than 40%, for a period or periods aggregating no more than 3 minutes in any one hour.

e. The provisions of I.A.1 shall not apply to fugitive dust. See instead Section II.D. of this regulation.

B. Transportation Sources:

1. Four-cycle gasoline-powered vehicles:

No person shall emit or cause to be emitted into the atmosphere for a period greater than 5 consecutive seconds from any four-cycle gasoline-powered vehicle whatsoever any visible air contaminant.

2. Two-cycle gasoline-powered vehicles:

No person shall emit or cause to be emitted from any two-cycle gasoline-powered vehicle into the atmosphere any visible air contaminant which is of such a shade or density as to obscure an observer's vision to a degree equal to or greater than 20% opacity, except for a period not exceeding 10 consecutive seconds.

3. Diesel-powered vehicles:

a. No person shall emit or cause to be emitted into the atmosphere from any diesel-powered vehicle operating below 8,000 feet (mean sea level) any air contaminant, for a period greater than 10 consecutive seconds, which is of such a shade or density as to obscure an observer's vision to a degree in excess of 30% opacity. (66-31-8(2)(a) and (b), 66-31-8(3)(a) and (b)).

b. No person shall emit or cause to be emitted into the atmosphere from any diesel-powered vehicle operating above 8,000 feet (mean sea level) any air contaminant, for a period greater than 10 consecutive seconds, which is of such a shade or density as to obscure an observer's vision to a degree in excess of 40% opacity. (66-31-8(2)(a) and (b) and 66-31-8(3)(a) and (b)).

c. Exceptions:

c-1. Emissions from diesel-powered vehicles exceeding the requirements of Part B Sections 3(a) and (b) of these regulations shall be exempt for a period of twenty (20) minutes if the emissions are a direct result of a cold engine start-up and provided the vehicle is in a stationary position. (66-31-8(4)).

c-2. All off-highway heavy duty diesel-powered vehicles shall be exempt from the provisions of Part B Sections 3(a) and (b) for nonconsecutive periods of fifteen (15) seconds. (66-31-8(4).

4. Diesel-Powered Locomotives:

a. Until July 1, 1978 no person shall emit or cause to be emitted into the atmosphere from any diesel-powered locomotive any air contaminant which is of such a shade or density as to obscure an observer's vision to a degree in excess of 30% opacity below 6,000 feet (mean sea level) and 40% opacity above 6,000 feet (mean sea level). (66-31-8(2)(a) and (b), and 66-31-8(3)(a) and (b)).

b. After July 1, 1978 no person shall emit or cause to be emitted into the atmosphere from any diesel-powered locomotive any air contaminant which is of such a shade or density as to obscure an observer's vision to a degree in excess of 20% opacity below 6,000 feet (mean sea level) and 30% opacity above 6,000 feet (mean sea level). (66-31-8(2)(a) and (b), and 66-31-8(3)(a) and (b)).

c. Exceptions to Parts I.B.4(a) and (b).

c-1 Opacity emissions as a result of a cold engine start-up not to exceed thirty (30) consecutive minutes provided the locomotive is in a stationary position. (66-31-8(4)).

c-2 Opacity emissions for nonconsecutive periods of three (3) minutes with an aggregate of not more than ten (10) minutes in one hour when a locomotive engine is being tested, adjusted, rebuilt or repaired in the maintenance yards. (66-31-8(4)).

c-3 Opacity emissions for nonconsecutive periods of four (4) minutes when a locomotive is accelerated after standing still. (66-31-8(4)).

c-4 Until July 1, 1978 when diesel locomotives are used for switching, opacity emissions are not to exceed 40% opacity except for nonconsecutive periods of fifteen (15) seconds; however, opacity emissions are never to exceed 50% opacity. (66-31-8(4)).

d. The owner or operator of any diesel powered vehicles that have been cited for violation of Section I.B.4 of this regulation, but that are unavailable for a compliance inspection, shall submit to the Division an affidavit attesting to those abatement measures which have been completed and shall state in that affidavit that the vehicles cited have achieved compliance with this regulation.

SOURCE: Section C - Open Burning,
Repealed and Readopted February 8, 1973, Effective May 1, 1973:

C. Open Burning:

1. No person shall burn or permit to be burned on any open premises owned or controlled by him, or on any public street, alley, or other land adjacent to such premises, rubbish, waste, paper, wood, or other flammable material unless a permit therefor shall first have been obtained from the appropriate authority enforcing air pollution control standards or the designee of the Air Pollution Control Division. In granting or denying the issuance of any such permit, said authority shall base its action on the

location and proximity of such burning to any building or other structure, the potential contribution of such burning to air pollution in the area, climatic conditions on the day or days of such burning, and compliance by the applicant for the permit with applicable fire protection and safety requirements of the local authority or area, and the air pollution control authority is satisfied that there is no practical alternative method for the disposal of the material to be burned or to conduct the desired activity and that the open burning is conducted in such a reasonable manner so as to minimize emissions including but not limited to the use of non-approvable incinerators and air curtain destructors, the use of auxiliary clean fuel, drying the material prior to ignition and separating out for alternate disposal: rubber, tires, plastics, wire, insulation and other similar smoke-producing material. (66-31-8(2)(a), (b), (f), and 66-31-20)).

2. Exceptions:

   a. The provisions of Part I Section C of these regulations shall not apply to non-commercial burning of private household trash except

      a-1. Inside such air pollution control areas as have been or shall have been or shall be designated by the Air Pollution Control Commission. (see Exhibit No. 1).

      a-2. Inside a 2-mile boundary from the corporate limits of any city or town with a population of over 500 as determined by the latest Federal census and

      a-3. Inside any area the Commission has designated as having a reasonable alternative to open burning including but not limited to a refuse collection system and sanitary landfill. (66-31-8(4)).

   b. Fires used for non-commercial cooking of food for human beings or for instructional or recreational purposes shall be exempt from Part I, Section C of these regulations. (66-31-8(4)).

   c. Smokeless flares or safety flares for the combustion of waste gases shall be exempt from Part I, Section C of these regulations. (66-31-8(4)).

d. **Flares used to indicate some danger to the public shall be exempt from Part I, Section C of these regulations. (66-31-8(4)).**

e. Emissions from fireplaces used for non-commercial, recreational or aesthetic purposes shall be exempt from Part I.C.1 of this regulation outside those areas designated in Section C.2.a. hereof. Inside those areas, fireplace fuel shall be limited to dry wood, dry paper, or smokeless fuel. (66-31-8(4)).

II. PARTICULATE EMISSION REGULATIONS

A. Fuel-Burning Equipment:

1. No person shall cause or permit to be emitted into the atmosphere from any fuel-burning equipment, or to pass a convenient measuring point near any opening, particulate matter in the flue gases which exceed 0.5 pounds per 1,000,000 BTU heat input for fuel-burning units generating not more than 1,000,000 BTU per hour total input. For single units generating 1,000,000 BTU per hour or more total input, Figure 1 on the following page will be used to determine the allowable particulate emission limitation. For fuel-burning equipment generating 500 million BTU input per hour or more, particulate matter in the flue gases cannot exceed 0.1 pounds per million BTU heat input. If two or more units connect to any opening, each unit shall, for the purpose of computing the maximum allowable emission rate, be considered a separate entity with the allowable emission rate for the opening the sum of the individual computations. (66-31-8(2) and (c), and 66 13-8(3)(a)).

   Typical Values from Figure 1 are shown in TABLE I.

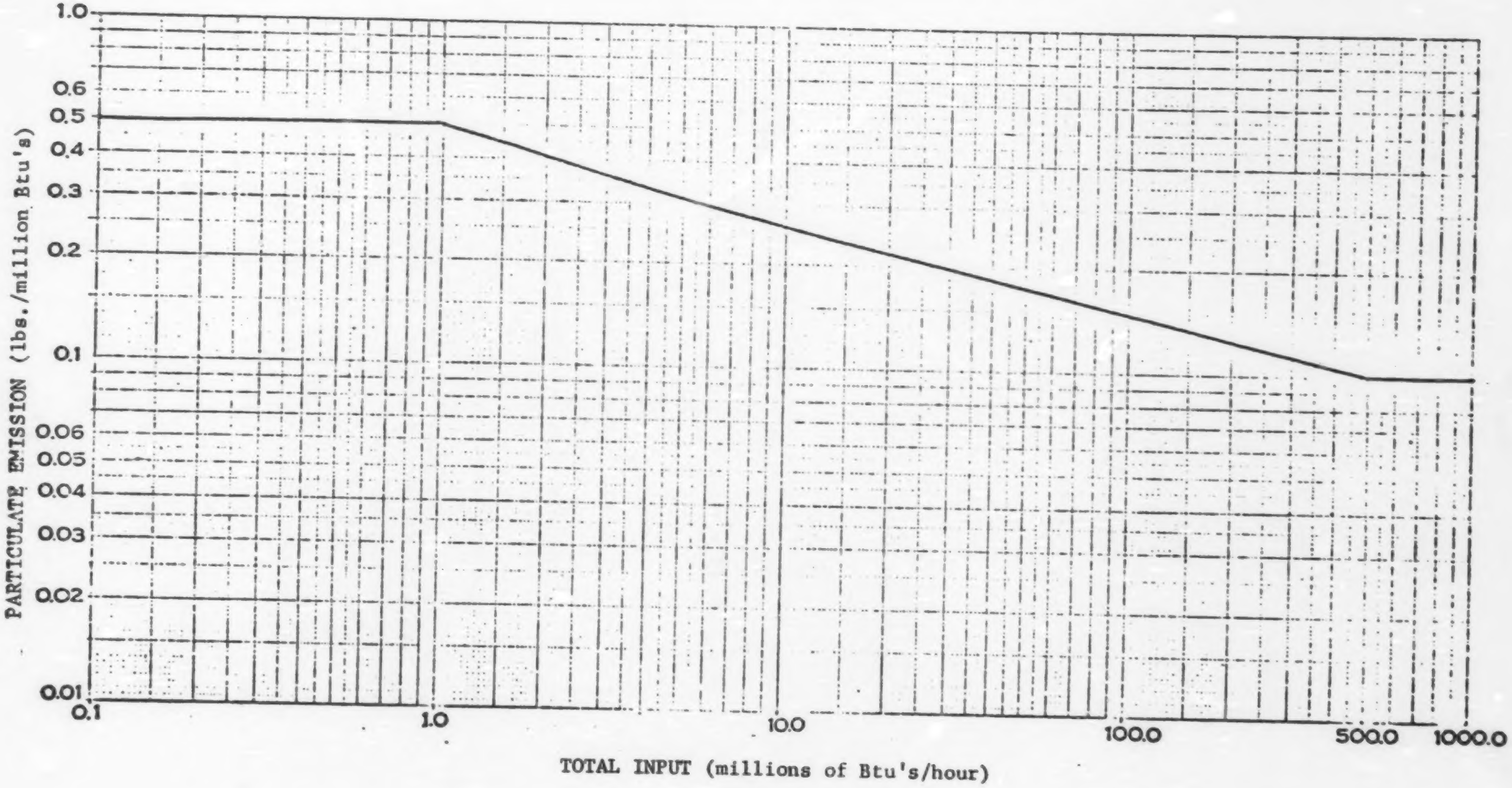

Figure 1. Fuel burning equipment

II. A (continued)

TABLE I

Fuel Input	Particulate Emissions	Fuel Input	Particulate Emissions
10^6 BTU/hr.	lbs./10^6BTU	10^6 BTU/hr.	lbs./10^6 BTU
0.1	0.50	100	0.15
1.0	0.50	500	0.10
10.0	0.27	1000	0.10

Interpolation of the data in TABLE I for fuel-burning equipment shall be by use of the following equations;

$$PE = 0.5 \qquad FI \underline{\angle} 1.0$$

$$PE = 0.5\ (FI)^{-0.26} \qquad 1.0 \underline{\angle} FI \underline{\angle} 500.0$$

$$PE = 0.1 \qquad 500.0 \underline{\angle} FI$$

Where: PE = Particulate Emission in pounds per million BTU
FI = Fuel Input in million BTU per hour
$\underline{\angle}$ Less than or equal to (if "FI" is to the left of the symbol).
Greater than or equal to (if "FI" is to the right of the symbol)

2. Method of Measurement:

   a. Emission rates shall be measured according to the American Society of Mechanical Engineer's Power Test Codes - PTC-27 dated 1957 and entitled, "Determining Dust Concentrations in a Gas Stream" or any equivalent method which has been approved by the Air Pollution Control Division in advance of such measurement. (66-31-8(2)(a) and (c) and 66-31-8(3)(a)).

NOTE: THIS AMENDMENT TO REGULATION NO. 1, SECTION II.B. ENTITLED, "INCINERATORS" RESCINDS AND REPLACES SECTION II.B. ENTITLED, "REFUSE BURNING EQUIPMENT."

ADOPTED : September 8, 1972
EFFECTIVE: November 30, 1972

II.

B. Incinerators:

1. Permits:

No person shall construct or operate any incinerator without a permit from the Division. (66-31-10(2)(g) and 66-31-20).

a. A permit to operate will be issued for a one-year period subject to renewal.

b. No permit shall be granted until the applicant demonstrates that the incinerator meets the criteria of Section 66-31-20 of the Act, and is constructed and operated to meet all the regulations of the Commission.

c. Inside designated air pollution control areas and other areas outlined under Section I.C.2.a. of this regulation, the use or operation of any incinerator on property devoted to residential use is prohibited and no permit shall be granted for its use.

2. Exemptions:

a. The prohibition of Section II.B.c. shall not apply to existing residential incinerators until January 1, 1977.

b. Incinerators without a valid permit may be used for the non-commercial burning of private household trash where such open burning is allowed. (See Section I.C. of this regulation).

II. B - (continued)

3. Standard of Design and Performance:

   a. Inside designated air pollution control areas (shown on Exhibit No. 1) no person shall cause or permit an emission of more than 0.10 grain of particulate matter per standard cubic foot (dry flue gas corrected to 12% carbon dioxide) into the atmosphere from any new incinerator. From any existing incinerator, no person shall cause or permit an emission of more than 0.15 grain of particulate matter per standard cubic foot. Effective January 1, 1977 existing incinerators shall meet the grain loading requirement of this section for new incinerators. (66-31-8(2)(a) and (c), and 66-31-8(3)(a) and (b).

   b. Outside designated air pollution control areas, no person shall cause or permit an emission of more than 0.15 grain of particulate matter per standard cubic foot (dry flue gas corrected to 12% carbon dioxide) into the atmosphere from any incinerator.

4. Method of Measurement:

   a. Emission rates shall be measured according to the American Society of Mechanical Engineer's Power Test Codes - PTC-27 dated 1957 and entitled, "Determining Dust Concentrations in a Gas Stream" or any equivalent method which has been approved by the Air Pollution Control Division in advance of such measurement. The test data shall reflect particulate gas stream concentrations consistent with the rated capacity of the incinerator, and corrections for carbon dioxide will be made without the contribution of carbon dioxide from auxiliary fuel. (66-31-8(3)(a) and (b)).

5. Amendments to this section shall become effective November 30, 1972.

II.

C. Manufacturing Processes:

1. No person shall cause or permit any emission into the atmosphere in any 60 consecutive minutes from any opening whatsoever, particulate matter in quantities in excess of the emission rates as shown in Figure 2. If two or more process units connect to an opening each process unit shall, for the purpose of computing the maximum allowable emission rate, be considered a separate entity with the allowable emission rate for the opening the sum of the individual computations. (66-31-8(2), (a) and (c), and 66-31-8(3)(a) (f) and (g)).

   Typical Values from Figure 2 are shown in TABLE II.

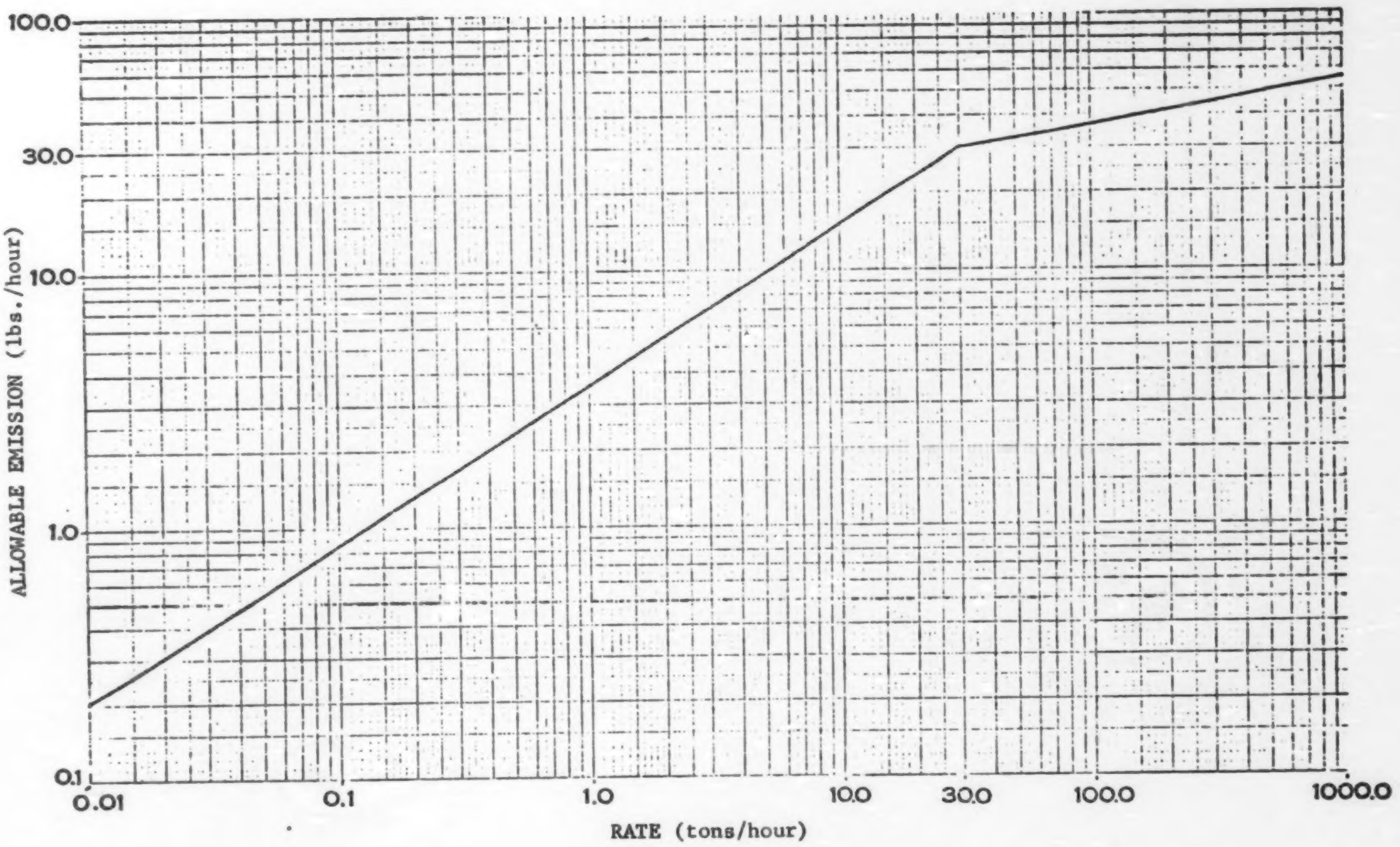

Figure 2. Process weight rate

II.C(continued)

TABLE II

Process Weight Rate lbs./hr.	Emission Rate lbs./hr.	Process Weight Rate lbs./hr.	Emission Rate lbs./hr.
50	0.03	5,000	6.34
100	0.55	10,000	9.73
500	1.53	20,000	14.99
1,000	2.25	60,000	29.60

Process Weight Rate tons/hr.	Emission Rate lbs./hr.	Process Weight Rate tons/hr.	Emission Rate lbs./hr.
40	31.19	100	36.11
60	33.28	200	40.35
80	34.85	500	46.72

Interpolation of the data in Table II for the process weight rates up to 60,000 lbs./hr, shall be by use of the equation:

$$E = 3.59 P^{0.62} \qquad P \underline{\angle} 30 \text{ tons/hr.}$$

and interpolation and extrapolation of the data for process weight rates in excess of 60,000 lbs./hr. shall be by use of the equation:

$$E = 17.31 P^{0.16} \qquad 30 \text{ tons/hr.} \underline{\angle} P$$

Where: E = Emissions in pounds per hour.
P = Process weight rate in tons per hour.

$\underline{\angle}$, Less than or equal to (if "P" is to the left of the symbol).
Greater than or equal to (if "P" is to the right of the symbol)

2. Method of Measurement:

Emission rates shall be measured according to the American Society of Mechanical Engineer's Power Test Codes - PTC-27 dated 1957 and entitled, "Determining Dust Concentrations in a Gas Stream" or any equivalent method which has been approved by the Air Pollution Control Division in advance of such measurement. (66-31-8(2)(a) and (c), and 66-31-8(3)(a), (f) and (g)).

D. Fugitive Dust:

1. Effective Date and Affected Areas.

   a. The existing Section II.D. of Regulation No. 1 controlling fugitive dust shall be repealed effective July 31, 1974 and the new Section II.D as follows shall become effective August 1, 1974. This delayed effective date for the new Section II.D allows time for voluntary compliance with the new provisions.

   b. Sections II.D.3, 4 and 5 shall apply only to Commission designated air pollution control areas as shown on page 1.13 of this Regulation No. 1.

   c. Sections II.D.2, 6, 7, 8, and 9 shall apply statewide.

2. Opacity Regulations for Fugitive Dust Emissions Emanating from Unenclosed Operations.

   a. No person shall emit or cause to be emitted from any source of fugitive dust whatsoever, any particulate matter which,

      (i) at or from the source of said emission, is of such a shade or density on the property of emission origination so as to obscure an observer's vision to a degree in excess of 20% opacity, or

      (ii) is visibly transported off the property of emission origination and remains visible to an observer positioned off said property when sighting along a line which does not cross the property of emission origination.

   b. Exceptions from Opacity Regulation Section II.D.2(a).

      (i) All unpaved roads and unpaved parking lots (covered by Section II.D.3).

      (ii) Earth and construction-material moving and excavating activities except for crushing, grinding, milling, conveying, and bagging processes. (covered by Section II.D.4).

      (iii) Demolition, wrecking, and moving of structures and explosives detonation activities. (covered by Section II.D.5).

(iv) Open mining activities. (covered by Section II.D.6).

(v) Agricultural cultivation activities (regulated in part by Section II.D.7).

(vi) Sources of fugitive dust which exceed opacity regulations for a period or periods aggregating less than three (3) minutes in any sixty (60) consecutive minutes.

(vii) Sources of fugitive dust from which dust emissions exceed opacity regulations when wind velocities exceed 30 m.p.h. as determined by one or more of the following practices as approved by the Division: By a one-hour average at the nearest official station of the U.S. Weather Service; by interpretation of surface weather maps by a qualified meteorologist; or by use of one or more anemometers at the site.

(viii) any other sources as specified by the Commission.

3. Unpaved Roads and Unpaved Parking Areas.

a. All new unpaved roads and unpaved parking areas:

a-1 No person shall construct or operate a new unpaved road, or new unpaved parking area unless a permit therefore has been granted by the Division pursuant to Section II.D.8.

a-2 Exceptions:

(i) Any new road or parking area which, after demonstration to the Division, will not exceed an average daily traffic count of 165 vehicles averaged over any consecutive 3-day period.

(ii) Any new road or parking area associated solely with housing or apartment projects of seven family dwelling units or less.

(iii) Any new road or parking area to be hard surfaced (concrete or bituminous binder and rock) within six (6) months of start of construction, except that the person constructing or contracting to construct said road or parking area shall notify the Division in advance of commencing construction of the nature, size, and location of the hard surfacing project and the dates on which the road or parking area construction project is to start and is to be completed. The person shall use abatement and preventive measures as outlined in II.D.9 during construction.

a-3 The Division may require the person owning or maintaining any new or existing unpaved road to supply traffic count information on a regular basis to the Division as necessary to determine if additional abatement and preventive measures or changes in the implementation time schedule are required of the person by the Division.

b. Existing Privately Owned or Maintained Unpaved Roads and Unpaved Parking Areas.

b-1 Any person owning any unpaved road or unpaved parking area or having a right-of-way easement or possessory right to use the same, found by the Division to exceed a maximum allowable traffic count of 165 vehicles per day averaged over any consecutive 3-day period, shall discontinue and prevent use of that road or parking area, unless the Division has approved a fugitive dust control plan which includes preventive measures as outlined in II.D.9 and unless the conditions of the approved plan are met continually.

c. Existing Publicly Owned or Maintained Unpaved Roads and Unpaved Parking Areas.

c-1 By July 1 of each year the Division shall submit to the political subdivision owning or maintaining unpaved roads or unpaved parking areas and to the Commission, a report on the nature and degree of emissions from existing unpaved roads and parking areas within said political subdivisions which exceed 165 vehicles per day averaged over any 3-day period based upon traffic count information as collected by the Division or the political subdivision.

c-2 Said political subdivisions shall submit a plan and progress report to the Division by October 1 of each year which includes a specified time schedule for the control of fugitive dust emissions on unpaved roads and unpaved parking areas as reported by the Division pursuant to Section II.D. 3 (c-1). Said plans shall be based upon:

(i) availability of existing and new funds for paving or fugitive dust suppression;

(ii) use of preventive measures applicable to unpaved roads and unpaved parking areas as outlined in Section II.D.9.

4. Earth and Construction-Material Moving and Excavating except for Crushing, Grinding, Milling, Conveying and Bagging Processes.

No land developer of a new, or owner of an existing construction or land development project shall throughout the duration of the project, disturb or contract to disturb by grading, excavating or depositing on more total surface area than five (5) acres of land (in the aggregate) unless abatement and preventive measures as outlined in Section II.D.9 are being met continually. New sources regulated in this paragraph 4 must be granted a permit from the Division purusant to Section II.D.8 prior to breaking ground.

5. Demolition, Wrecking and Moving of Structures and Explosives Detonation Activities.

a. No person shall conduct demolition, wrecking, or moving of structures of explosives detonation activities unless a permit therefore has been granted by the Division pursuant to Section II.D.8 and unless the provisions of Section II.D.9 are being met continually.

6. Open Mining Activities:

No developer of a new or owner of an existing open mining activity shall throughout the duration of the operation, disturb or contract to disturb by grading, excavating, or depositing on more total surface area than one (1) acre of land (in the aggregate) unless the provisions of Section II.D.9 are being met continually. New open mining activities must be granted a permit from the Division pursuant to Section II.D.8 prior to operation. Open mining shall mean the mining of natural mineral deposits, limestone, coal, sand, gravel, and quarry aggregate, by removing the overburden lying above such deposits and mining directly from the deposits thereby exposed. The term includes, but is not limited to, such practices as open cut mining, open pit mining, strip mining, quarrying, and dredging.

7. Complaint Section:

When a complaint of dust or fugitive dust is registered with the Division by a single complainant or multiple complainants who allege that any dust or fugitive dust obstructs or interferes with the reasonable and comfortable use of his or their property, the Division shall investigate and if the Division finds that such conditions exist, the Division shall issue a citation to the person or persons from whose land or activity the objectionable emission emanates and shall require a fugitive dust control plan containing reasonable control measures where appropriate according to the abatement and preventive measures as outlined in Section II.D.9.

8. New Source Permit Requirements:

   a. No permit shall be granted to an applicant unless the Division determines to its satisfaction that a plan has been submitted on forms provided by the Division which includes the following information:

a-1 A description of the nature and scope of the activity and of the existing or new sources of fugitive dust including but not limited to the following:

- excavating
- land leveling
- repair or alteration
- sand blasting
- vehicle movement
- screening
- drying
- waste disposal
- detonation of explosives
- earth moving
- construction
- demolition
- handling
- transporting
- mining activities
- crushing
- site preparation
- feed lots
- campgrounds
- fairgrounds
- processing of sand, gravel and rock
- cleaning
- mixing
- miscellaneous uses of land
- storage
- quarrying
- unpaved roads
- unpaved parking areas

a-2 Fugitive dust abatement and preventive measures as outlined in Section II.D.9.

a-3 A time schedule for fugitive dust abatement and prevention.

a-4 A description of any monitoring or sampling methods used for recording and reporting data to the Division.

b. The permit may be granted and renewed for any period of time as deemed appropriate by the Division.

c. The permit may be granted to any single applicant for any single project or combination of projects as deemed appropriate by the Division.

d. In the granting of a permit, the Division may impose any permit condition it deems necessary to attain and maintain compliance with the provisions of this Section II.D.

e. The Division may suspend, revoke, modify, or refuse to renew or grant a permit under the following conditions:

(i) the requirements of this Section II.D. have not been met;

(ii) the approved compliance or prevention plan has not been followed as determined by the Division, or

(iii) the permit conditions are not met.

f. Any appeal by an applicant of a denial or revocation of a permit shall be conducted in accordance with the provisions of Sections 66-31-12(4)(f), (g), and (h) of the Act.

9. List of Abatement and Preventive Measures.

a. Unpaved Roads and Unpaved Parking Areas.

a-1 Abatement and preventive measures shall be approved by the Division and may include but shall not be limited to frequent watering, addition of dust palliatives, detouring, paving, closure, speed control, or other means such as surface treatment with penetration chemicals (ligninsulfonates, oil, water, cutbacks, etc.) or methods of equal or greater effectiveness in reducing the air contamination produced.

b. Demolition, Wrecking and Explosive Detonation Activities; Earth and Construction Material Moving, Mining and Excavation Activities.

b-1 Abatement and preventive fugitive dust control measures shall be approved by the Division and may include, but shall not be limited to:

- wetting down, including pre-watering;
- landscaping and replanting with native vegetation;
- covering, shielding or enclosing the area;
- paving, temporary or permanent;
- treating, the use of dust palliatives and chemical stabilization;
- detouring;
- restriction of the speed of vehicles on sites;
- prevention of the deposit of dirt and mud on improved streets and roads and other such effective means of dust control as the Division may deem necessary;
- disturbing less topsoil and reclaiming as soon as possible.

b-2 Sequential blasting shall be employed whenever or wherever feasible to reduce the amounts of unconfined particulate matter;

b-3 Such dust control strategies as re-vegetation, delay of surface opening until demanded, or surface compaction and sealing, shall be applied.

b-4 Haulage equipment shall be washed or wetted down, treated, or covered when necessary to minimize the amount of dust emitted in transit and in loading.

b-5 These measures shall also be enforced during periods when actual construction work is not being conducted, such as on weekends and holidays.

3. When not fewer than five complaints of objectionable fugitive dust are registered with the Division, and earlier at the option of the Division, it shall be the responsibility of the Division to investigate the complaints to determine if a violation of this regulation has occurred and to identify the source or sources of the fugitive dust and the circumstances surrounding its emission.

III. SULFUR DIOXIDE EMISSION REGULATIONS:

A. Ground Level Concentrations:

1. No person shall cause or permit any emission of sulfur dioxide which causes a 5-minute average ground level concentration greater than 0.25 parts per million (by volume) more frequently than once in any 8 hours; or a 1-hour average ground level concentration greater than 0.1 parts per million (by volume) more frequently than once in any 4 days; or a 24-hour average ground level concentration greater than 0.05 parts per million (by volume) more frequently than once in any 90 days. Such limitations shall not apply to ground level concentrations occurring on the property from which the emission occurs, provided such property, from the emission point to the point of any such concentration, is controlled by the person responsible for the emission. (66-31-8(2)(a) and (d)).

SOURCE: Section B, Source Emission Concentrations, Amended February 8, 1973, effective May 1, 1973:

B. Source Emission Concentrations:

1. No person shall emit or cause to be emitted sulfur dioxide emissions in excess of 500 ppm from any process unit.

2. Effective January 1, 1978, no person shall emit or cause to be emitted sulfur dioxide emissions from a process unit.

   a. in excess of 500 ppm from any opening and,
   b. greater than 5 tons SO_2 per day from any process unit.

3. The limitations of Section III.B.2 shall not apply to emissions of sulfur dioxide of less than 150 ppm.

4. On or before July 1, 1975, all owners and operators of existing sources of sulfur dioxide, which can not show to the Division by that date that their source or sources are in compliance with Section III.B.2 or 3 of this Regulation, shall submit an acceptable compliance plan pursuant to Regulation No. 3 (Authority to Construct and Permit to Operate) designed to meet Section III.B.2 or 3 by January 1, 1978.

5. New air contamination sources to be constructed or contracted for construction after January 1, 1975, shall meet the 1978 emission standard provided herein even if operation commences prior to 1978.

III. SULFUR DIOXIDE EMISSION REGULATIONS

B Illustration of SO_2 Source Emission Concentration Requirements

EFFECTIVE DATE	EXISTING SOURCES	NEW SOURCES
Regulation Adoption Date	500 ppm maximum concentration	500 ppm maximum concentration
January 1, 1975		Source to be constructed or contracted must be designed for: 500 ppm and 5 Tons/day Maximum Emission -OR- 150 ppm Maximum Emission
July 1, 1975	Submittal under Regulation No. 3, detailed compliance schedules and control equipment plans.	
January 1, 1978	500 ppm and 5 Tons/day Maximum Emission -OR- 150 ppm Maximum Emission	

C. Method of Measurement

1. For the purposes of Section A of this Regulation, measurements of sulfur dioxide shall be made by the most recent published method of the Intersociety Committee for a Manual of Methods for Ambient Air Sampling and Analysis ((See e.g., Health Laboratory Science 7 (1) 4-12 (1970)) or any equivalent method which has been approved by the Air Pollution Control Division in advance of such measurement.

2. For the purposes of Section B of this regulation, measurements of sulfur dioxide shall be made by "An Absorption-Titration Method" ((e.g., J.S. Fritz and S.S. Yamamura, Analytical Chemistry 27 (9) 1461 (1955) and E.B. Seidman, Analytical Chemistry 30 (10) 1680 (1959)) or any equivalent method which has been approved by the Air Pollution Control Division in advance of such measurement.

D. Related Compounds containing sulfur in oxidized states:

1. For the purposes of this Regulation, all oxidized forms of sulfur (including, but not restricted to, SO_3, $SOCl_2$, H_2SO_4 mist) shall be considered as sulfur dioxide.

2. Quantities of such oxidized sulfur compounds, as measured by procedures established in Section C above, shall be converted on a molar basis to an equivalent quantity of sulfur dioxide. The total of all such quantities, parts per million by volume sulfur dioxide plus parts per million by volume sulfur-dioxide-equivalents of other oxidized forms, shall be interpreted as "parts per million by volume sulfur dioxide" as used in Sections A and B above.

IV. EFFECTIVE DATE:

These Regulations as adopted amend and supersede Commission Regulation No. 1 upon the effective date hereof, to wit:

February 1, 1972.

REGULATION NO. 2

Odor Emission Regulations

Colorado Air Pollution Control Commission

Adopted : March 11, 1971
Effective Date: April 20, 1971

COLORADO DEPARTMENT OF HEALTH
Air Pollution Control Commission
4210 East 11th Avenue
Denver, Colorado 80220

Adopted : March 11, 1971
Effective Date: April 20, 1971

REGULATION 2

ODOR EMISSION REGULATIONS

Pursuant to Section 66-31-8(2)(e) of the Colorado Air Pollution Control Act of 1970, the following Emission Regulations are issued:

A. No person, wherever located, shall cause or allow the emission of odorous air contaminants from any single source such as to result in detectable odors which are measured in excess of the following limits:

(1) For areas used predominantly for residential or commercial purposes it is a violation if odors are detected after the odorous air has been diluted with seven (7) or more volumes of odor free air.

(2) In all other land use areas, it is a violation if odors are detected after the odorous air has been diluted with fifteen (15) or more volumes of odor free air.

(3) (a) When the source is a manufacturing process or agricultural operation, no violation of Subsections (1) and (2) shall be cited by the Division, provided that the best practical treatment, maintenance, and control currently available shall be utilized in order to maintain the lowest possible emission of odorous gases and, where applicable, provided there is compliance with Item 4r of the Colorado Department of Health Pasteurized Fluid Milk and Milk Products Regulation adopted 18 April 1967. In determining the best practical control methods, the Division shall not require any method which would result in an arbitrary and unreasonable taking of property or in the practical closing of any lawful business or activity, if such would be without corresponding public benefit.

(b) For all areas it is a violation when odors are detected after the odorous air has been diluted with one hundred twenty-seven (127) or more volumes of odor free air in which case provisions of Paragraph A(3)(a) shall not be applicable.

B. For the purposes of this Regulation, two odor measurements shall be made within a period of one hour, these measurements being separated by at least fifteen (15) minutes. These measurements shall be made outside the property line of the property from which the emission originates.

C. For the purposes of this Regulation, personnel for evaluating odors shall be selected using an "intensity rating test" as outlined in "Selection and Training of Judges for Sensory Evaluation of the Intensity and Character of Diesel Exhaust Odors." USPHS Pub.#999-AP-32.

D. The Barnebey Cheney Scentometer, suitably calibrated, or any other instrument, device, or technique designated by the Colorado Air Pollution Control Division, may be used in the determination of the intensity of an odor and may be used as a guide in the enforcement of this Regulation.

E. The provisions of this Regulation shall apply throughout the State of Colorado.

REGULATION NO. 3

Regulation Governing Authority to Construct and Permit to Operate

Colorado Air Pollution Control Commission

Adopted : December 9, 1971
Effective Date: February 1, 1972

Adopted : December 9, 1971
Effective Date: February 1, 1972

REGULATION NO. 3

Regulation Governing Authority to Construct and Permit to Operate

I. INSTRUCTIONS, PROCEDURAL GUIDELINES, AND SAMPLE FORMS FOR FILING AN AIR CONTAMINANT EMISSION NOTICE:

The Act requires an "air contaminant emission notice" be filed with the Department prior to the emission of an air contaminant from any facility, process, or activity. The Commission has defined insignificant sources exempted from filing a notice as listed in IV.A of Regulation No. 3. Any facility, process, or activity which is altered and results in an increase in emission of air contaminants must also file an "air contaminant emission notice" with the Department with respect to such proposed emission. A revised emission notice is required and shall be filed whenever a significant change in emissions shall have occurred. (See instructions)

Effective July 10, 1970, no person shall discharge, or cause to be discharged, into the atmosphere any air contaminant if an "air contaminant emission notice" has not been filed. Failure to comply with this provision of the Act is punishable by a fine of not more than one hundred dollars ($100).

The Air Contaminant Emission Notice may be obtained from the Colorado Department of Health (see below) or from any local air pollution control agency in Colorado.

The Air Contaminant Emission Notice is to be completed in triplicate and all copies mailed to:

COLORADO DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL DIVISION
4210 East 11th Avenue
Denver, Colorado 80220

AIR CONTAMINANT EMISSION NOTICE

I. INSTRUCTIONS:

A. GENERAL SOURCE INFORMATION:

To be completed in detail by all persons that are required to file the "Air Contaminant Emission Notice."

B. PROCEDURES:

1. The Air Contaminant Emission Notice shall be prepared in accordance with the requirements of Section 66-31-12(2) of the Act.

   "Each notice shall specify the location at which the proposed emission will occur, the name and address of the person operating or owning such facility, process, or activity, and the nature of such facility, process, or activity, and an estimate of the quantity and composition of the expected emission. The Division shall make available at all air pollution control authority offices appropriate forms on which the information required by this section shall be furnished."

2. The person filing the Notice shall use forms provided by the Division in supplying the necessary information. The person must make a reasonable effort to answer all applicable questions and to supply any pertinent information even though the forms and questions do not specifically request the information.

3. If the Division finds the Emission Notice to be incomplete or not filed with information as required in Section 66-31-12 of the Act, the Division may require in writing the required information.

4. The Division may require chemical analysis of a sample of any raw materials, fuels, or emissions which may help determine the identity and quantity of significant air contaminants.

C. FUEL COMBUSTION INFORMATION:

1. List the fuel used in the appropriate space provided and the percent used for space heating and for process heat.

2. List the type of fuel-burning equipment, collection equipment, or control equipment used and the expected efficiency of collection or control equipment; for example, boiler, boiler cyclone, 80% collecting efficiency.

3. Give rated BTU input.

4. Stack height information must be submitted.

5. Check your fuel bills for meter readings to determine natural gas usage.

D. BASIC PROCESS OR EQUIPMENT USED:

1. For basic process equipment, only that equipment which is a source of air contaminant (controlled or uncontrolled) should be listed; for example, dryer solvent extractor, grinder, etc.

2. Under this section, list only that equipment which is associated with, or a part of, the listed basic process equipment in Section D.1 above; for example, boiler, kiln, scrubber, grinder, baghouse, dryer, cyclone, solvent extractor, afterburner, etc.

3. The amount of air contaminants should be tabulated. Where precise data is not available, an estimate subject to later verification may be made.

E. MANUFACTURING ACTIVITIES INFORMATION:

If the reporting of raw material or product data reveals confidential information, indicate so on the form and submit under separate cover appropriately identified as confidential information. Only report products manufactured if the product results directly in the emission of an air contaminant.

1. Principal raw materials should be listed; for example, units of rock crushed, chemicals consumed, materials processed, etc., per year.

2. Principal products manufactured might include number of bricks, cubic yards of concrete, barrels of fuel, etc., produced per year.

F. REFUSE DISPOSAL INFORMATION:

Indicate the method of disposal and the amounts per year for each method.

G. PROCESS FLOW DIAGRAM, ETC.:

May be a simple line drawing showing those points in the process involved with the emission of air contaminant. Indicate volumes, temperatures, and estimated quantities of the expected emission on the diagram as well as any supplemental information. Where space is limited submit a key to diagram on a separate form.

H. SOLVENT EVAPORATION AND LOSSES:

List the types of solvents used and the estimated quantities of solvents lost to the air because of evaporation.

AIR CONTAMINANT EMISSION NOTICE

SAMPLE

INSTRUCTIONS

This form shall include information relating to a single stack or vent. The process, fuel, and control information included shall relate to the emissions from this stack. Separate forms shall be filed for each stack or source of emissions.

A. General Information:

Record the city and county where the equipment is located, number of employees, land area, operating time, and percent throughput.

B. Stack Information:

This information must be completed by the applicant. The stack height shall be the measured height from ground level to the top of the stack or vent. Flow rate shall be given in actual cubic feet per minute at stack exit temperature and pressure.

C. Fuel Information:

Type of Unit:	This shall be the equipment that burns the fuel. Example: oil burner, coal burner, gas burner, or any other unit that utilizes fuel or involves combustion.
Design Rate:	Capacity of each fuel burning equipment (BTU/hr.).
Fuel Used:	Name the fuel used and print in the space, in line with the equipment that uses the fuel.
Consumption:	Print the amount of fuel used per year in units like tons/year, gallons/year, 10^6 SCF/year.
Heating Value:	This shall be given in BTU/unit of fuel.
Percent Annual Use:	This information shall be given for each fuel used separately, to total 100% per year.

D. Process Information:

Process Equipment:	List the major process equipment that causes or contributes to the emissions from this stack or vent.
Raw Materials, etc.	List all materials used during each process.
Units/year:	List amount of these materials used in proper units/year.
Design Rate:	This shall be the design rate of usage of raw materials of the process equipment and shall be given in proper units per hour.
Finished Products:	Name the finished products from these processes and print the units/year.

E. Control Equipment:

Primary and Secondary Controls:	All air pollution control equipment used on the emissions released by this particular stack or vent shall be reported. When two or more controls are used, the first type of control equipment in line will be the primary collector, and the others will be secondary controls.
Collection Efficiency:	This shall include the total efficiency of all the above control equipment.
Estimated Emissions:	This figure shall be estimated at the exit end of the stack or vent in tons/year.
Method of Estimation:	(e.g., source test, emission factors, experience with similar sources, or guesswork)

This submittal should include a sample block figure flow diagram showing all process equipment, flow of materials, and all emission points with emission estimates. Include manufacturers' brochures, if available.

Mail this information to:

Air Pollution Control Division
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220

APC-200A (11-72-20)

Colorado Department of Health
AIR CONTAMINANT EMISSIONS NOTICE

otice No.__________

Date__________

Original ☐
Follow Up ☐
Complaint ☐
Inventory ☐
New Plant ☐
Ex. Plant ☐
Alteration ☐

irm Name__________
ail Address__________ Zip__________
Plant Address__________ Zip__________
ontact Person__________ Title__________ Tel__________
eneral Nature of Business__________

his line for Health Dept use only

AQCR	Grid No.	Plant ID	Point ID	SIC	IPP Process	UTM Coordinates Horizontal	UTM Coordinates Vertical

A. GENERAL

City	County	No. Employees	Land Area	Normal Operation Hr./Day	Normal Operation Day/Wk.	Normal Operation Wk./Yr.	% Annual Thru Put Win.	% Annual Thru Put Spr.	% Annual Thru Put Sum.	% Annual Thru Put Fall

B. STACK OR VENT INFORMATION

Height (ft)	Exit Diameter (ft)	Temperature °F	Flow Rate (ACFM)	Moisture Content

C. FUEL INFORMATION

Type of Unit	Design Rate BTU/hr.	Fuel Used	Consumption Units/ Yr.	Heating Value	% Sulfur	% Annual Use Win.	% Annual Use Spr.	% Annual Use Sum.	% Annual Use Fall	Space Heat

PROCESS INFORMATION

Process Equipment Description	Raw Materials, Solvents, Cleaning Agents, Waste	Units Per Year	Design Rate Units/Hr.	Finished Products Units/Yr.

SAMPLE

CONTROL EQUIPMENT

Pollutants	Type of Control Equipment Primary	Type of Control Equipment Secondary	Collection Efficiency	Est. Emissions Tons/Yr.	Method of Estimation	Installation Date	Cost
rticulate							
SO							
NO_x							
HC							
CO							
ther (specify)							

Signature of Person
Supplying Data__________

COLORADO DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL DIVISION
4210 E. 11th Ave.
Denver, Colorado 80220
1-303-388-6111 ext. 241

200A-20

II. AUTHORITY TO CONSTRUCT:

A. GENERAL

No person shall construct or modify any new air contamination source mentioned in II.B without receiving written authorization from the Division.

B. Classes of machines, equipment, articles, or contrivances for which authority is required are the following:

1. Basic equipment.

   This class includes any machine, equipment, article or other contrivance associated with operations except as exempted in IV.A, the use of which may cause the emission of air contaminants.

2. Air pollution control equipment:

   This class includes any machine, equipment, article, or other contrivance associated with operations or processes except as exempted in IV.A, the use of which may eliminate or reduce or control the emission of air contaminants.

C. Applications:

Applications for authority to construct shall be prepared on appropriate application forms supplied by the Division and filed as outlined in IV.B.

D. Standards and Procedures for Granting or Denying Applications:

1. No authority to construct or modify shall be granted to the applicant unless the Division determines to its satisfaction that:

   a. The new air contamination source is so designed and will be constructed or modified to operate without causing a violation of the emission control regulations of the Commission, and any applicable national or local air pollution emission control ordinances and regulations.

   b. The new air contamination source is designed, built, and equipped in accordance with the best available practical methods to reduce, prevent, and control air pollution.

   c. The new air contamination source, as designed or modified does not significantly endanger maintenance or attainment as determined by criteria set forth in IV.C.2, of any ambient air quality standards of the Commission, and any more stringent national or local ambient air quality standards.

E. Conditional Approval of Applications:

1. An authority to construct or modify may be issued to an applicant owning or operating any new air contamination source subject to conditions which will make the equipment operate within the emission control regulations and ambient air quality standards of the Commission or applicable national or local air pollution control ordinances and regulations, and ambient air quality standards, in which case the conditions will be specified in writing. Commencing work under such an authority to construct shall be deemed acceptance by the applicant of all conditions specified.

2. The Division may impose conditions upon the applicant in the authority to construct or modify which require owners or operators of air contamination sources to install, maintain, and use instrumentation to monitor and record emission data as a basis for periodic reports to the Division.

F. Expiration of Authority to Construct:

The Division may cancel an authority to construct or modify if the construction or modification is not begun within six (6) months from the date construction is to be started as stated in the application, or if the work involved in the construction or modification is suspended for six (6) months or more. An applicant may secure an extension of the expiration date by written request to the Division stating the reasons for the request. Extensions may be granted for a period of not more than six (6) months.

III. PERMIT TO OPERATE:

A. No person shall begin operation of any new air contamination source mentioned in II.B of this Regulation without notifying the Division at least thirty (30) days prior to operation.

B. No person shall cause or permit the operation of any new air contamination source mentioned in II.B of this Regulation without applying for a permit to operate from the Division.

C. After January 1, 1975 no person shall cause or permit the use or operation of any existing air contamination sources mentioned in II.B of this regulation without first having been granted a permit to operate from the Division.

D. The requirement for a permit to operate shall be waived during the term of a variance.

E. No owner or operator shall cause or permit the operation of a new or existing air contamination source if the Division denies or revokes a permit to operate.

F. Applications:

Applications for permit to operate shall be prepared on appropriate application forms supplied by the Division and filed as outlined in IV.B.

G. Standards and Procedures for granting or denying Permit to Operate:

1. No permit to operate shall be granted unless the applicant shows to the satisfaction of the Division that the emissions of the air contamination source will satisfy the requirements of the emission control regulations of the Commission or any applicable national or local air pollution control ordinances and regulations and has been constructed, installed, or modified in accordance with the requirements and conditions contained in the authority to construct or modify.

2. After January 1, 1975 no existing air contamination source shall be granted a permit to operate unless the Division has determined to its satisfaction that said air contamination source will operate in such a manner so as not to significantly endanger maintenance or attainment as determined by the criteria set forth in IV.C.2 of any ambient air quality standards of the Commission, and any more stringent national or local ambient air quality standards.

3. Before a permit to operate is granted, the applicant, if required by the Division, shall conduct performance tests in accordance with methods approved by the Division with the tests being made at the expense of the applicant. The Division may monitor such required performance tests conducted by the applicant and may also conduct performance tests.

4. The Division may impose conditions upon the applicant in the permit to operate which require the owners or operators of air contamination sources to install, maintain, and use instrumentation to monitor and record emission data as a basis for periodic reports to the Division.

5. Prior to meeting the requirements of III.B and III.C. the Division may grant a temporary permit to operate to new or existing air contamination sources not to exceed six (6) months for the purpose of developing operational procedures, modifying equipment or facilities or to assess the impact of emissions to meet emission control regulations, ordinances and ambient air quality standards as determined by criteria set forth in IV.C.2.

H. Suspension or Revocation of Permit:

1. The Division may suspend or revoke a permit to operate if the requirements of Sections III and IV and any conditions specified in the permit to operate are not met on a continuous basis. Any order of the Division denying, suspending or revoking a permit to operate shall become final within ten (10) days from the receipt of the notice, unless the permittee shall have made a written application to the Commission for a hearing. The Commission may elect to refer the matter to the Variance Board for a decision as to whether the permit shall be granted, denied, or reinstated, or the operation be continued under the terms and conditions of a variance.

2. Whenever an air pollution emergency has been declared the permittee shall cease operating at such time after notice as shall have been stated in the permit to operate. Injunctive procedures may be instituted for failure to halt or curtail operation within the time specified in the permit. (66-31-11(1).

3. A permit to operate which has been revoked pursuant to these regulations shall be surrendered forthwith to the Division.

I. Renewal:

A permit to operate will be issued for a two-year period subject to renewal.

IV. COMMON PROVISIONS APPLICABLE TO BOTH AUTHORITY TO CONSTRUCT AND PERMIT TO OPERATE.

A. Exemptions:

An Air Contaminant Emission Notice, Authority to Construct, and Permit to Operate shall not be required for:

1. Structures used solely as residential dwellings and which do not exceed seven family units;
2. Retail and wholesale establishments where no processing or incineration occurs and where solid or liquid fuel is not burned;
3. Air conditioning or ventilating systems not designed to remove air contaminants generated by or released from equipment;
4. Fuel-burning equipment, other than smokehouse generators, which use gas as a fuel having a BTU input of not more than 500,000 BTU per hour;
5. Fireplaces used for inside or outside recreational purposes;
6. Fires used for non-commercial cooking of food for human beings;
7. The installation or alteration of an air contaminant detector, or air contaminant recorder.
8. Laboratory equipment used exclusively for chemical or physical analyses;
9. Flares used to indicate some danger to the public;
10. Normal agricultural cultivation operations.
11. Internal combustion engines are exempt except that emission notices and permit to operate are required for engines of greater than 1,000 horsepower.
12. Commercial laundries are only required to submit an air contaminant emission notice.
13. Other sources of minor significance as specified by the Commission.
    - *(a) Natural gas-fired indirect heat exchangers used as separators and known as heater treaters when used in oil and gas field operations when sweet gas is burned.
    - *(b) Multi-family dwellings, industrial and commercial establishments, (1) which have no emissions other than products of combustion from space heating by the use of natural gas, and (2) where no solid or liquid fuel is burned.

*Adopted June 8, 1972

B. Preparing and filing an application:

1. Separate applications are required for authority to construct or modify and permit to operate.

2. Applications shall be signed by the individual legally responsible and authorized to do so, and he thereby covenants that the applicant will either construct or modify the emission source in accordance with the requirements for granting applications as outlined in this regulation.

3. Prior to granting an authority to construct or permit to operate by the Division the applicant must submit, in triplicate, Form 200A entitled, "Air Contaminant Emission Notice."

4. Each application for authority to construct shall be accompanied by two copies of the complete data, siting (location) information, plans, descriptions, specifications and drawings sufficient in scope to allow an engineering evaluation to be made to determine whether appropriate air pollution control regulations, and ordinances and ambient air quality control standards will be met. For certain classes of equipment, special instruction forms are available which detail the information required. These forms can be identified as the Form 200B series.

5. Each application for permit to operate shall be accompanied by such performance tests results, information and records as may be required by the Division to determine whether the requirements of this regulation are met. Such information may also be required by the Division at any time when the source is being operated to determine compliance with applicable emission control regulations and ambient air quality standards.

C. Standards and Procedures for granting or denying **applications:**

1. Upon receipt and review of the application, but in no case later than twenty (20) days, the Division shall grant or deny, or request specific information from the applicant. Upon receipt of an application acceptable to the Division, within (20) days the Division shall either grant or deny permission to the applicant to construct, modify, or operate the new source.

2. If an authority to construct or permit to operate is granted the Division shall state, in writing, to the applicant and maintain a record of the maximum allowable emission levels the new or existing air contamination source must meet to comply with II.D. 1.(c), if II.D.1.(c) requires a more stringent degree of emission control than II.D.1.(a).

3. In the event of a denial of an application the Division shall not accept a further application unless the applicant has complied with the objections specified as reasons for denial.

4. Prior to the applicant being notified, in writing, of denial a conference between the Division and the applicant may be held to discuss the reasons for denial.

5. No authority to construct or permit to operate shall be granted to an applicant until the Division has determined to its satisfaction that acceptable halt or curtailment procedures which conform with the requirements of Section 66-31-11 of the Act have been submitted by the applicant. Such procedures shall state the times in which the applicant shall halt or curtail activities upon being notified of the declaration of an air pollution emergency.

Adopted : December 9, 1971
Effective: February 1, 1972

REGULATION NO. 4

Emission Control Regulations for Existing Wigwam Waste Burners

Colorado Air Pollution Control Commission

Adopted: May 25, 1972
Effective date: August 1, 1972

REGULATION NO. 4

Emission Control Regulations for Existing Wigwam Waste Burners

A. Effective August 1, 1972 through December 31, 1975, all existing wigwam waste burners shall be exempt from the provisions of Section I.A and II.B of Regulation No. 1 of the Commission and this Regulation No. 4 regarding wigwam waste burners shall apply instead. Commencing January 1, 1976, this Regulation No. 4 shall be terminated and Sections I.A and II.B of Regulation No. 1 shall again become effective.

B. New wigwam waste burners shall not be exempt from any portion of Regulation No. 1. The definition of existing wigwam waste burners shall include the addition of more effective devices for controlling air pollution to an existing wigwam waste burner; the replacement of an existing burner with a burner that emits less air contamination at the same location; or the resumption in the use of a phased out burner provided practical alternatives to the use of the burner do not exist.

C. No owner or operator of any existing wigwam waste burner shall cause or permit its use or operation after August 1, 1972 without a valid conditional permit to operate from the Division. This permit requirement shall remain effective through December 31, 1972.

1. No conditional permit to operate shall be granted until the applicant has clearly stated in writing to the satisfaction of the Division, consistent with any guidelines developed by the Division, the optimum state of maintenance and the operating procedures for that burner to operate so as to emit minimum air contaminants.

2. If the Division determines that practical alternatives to the use of a wigwam waste burner exist they may deny the permit to operate.

3. Any failure to meet the terms and conditions of the conditional permit to operate shall invalidate the permit and a cease and desist order shall be issued.

D. Effective January 1, 1973 through December 31, 1975, no person shall emit or cause to be emitted into the atmosphere, from any existing wigwam waste burner, any air contaminant for a period or periods aggregating more than three minutes in any sixty (60) consecutive minutes which is of such a shade or density as to obscure an observer's vision to a degree in excess of 20% opacity. Instrumentation which results in equivalent readings may be used in specific installations if approved in advance by the Air Pollution Control Division.

E. Section D shall not apply to the start-up time necessary for the building of fires in wigwam waste burners. Start-up time shall not exceed sixty (60) consecutive minutes, once every twenty-four (24) hours. The Division may further limit start-up time if practical methods exist.

F. Wood wastes shall be transported to the burner by continuous-flow conveying methods. Continuous-flow conveying methods means the transport of materials at uniform rates of flow, or at the rates generated by the production process.

G. In lieu of modifying burners to meet the requirements of Section D of this Regulation by January 1, 1973, the burner owner or operator may elect to cease burning. If the owner or operator intends to cease burning as opposed to meeting the opacity requirements by January 1, 1973, the owner or operator shall submit a burning cessation plan and schedule to the Variance Board prior to January 1, 1973, and the Variance Board may grant reasonable time, up to one year, for burning cessation beyond January 1, 1973.

H. During September of 1972, the Division and each owner or operator of a wigwam waste burner shall report, individually or cooperatively, before a joint meeting of the Commission and the Air Pollution Variance Board, the progress in meeting Section D of this Regulation which becomes effective January 1, 1973.

I. This regulation shall not apply to the use of a wigwam waste burner for the incineration of other than production process wood wastes. Wigwam waste burners used in whole or in part for the incineration of other than wood waste products shall be controlled in accordance with Regulations No. 1 and No. 3.

TIME SCHEDULE FOR THE IMPLEMENTATION OF REGULATION NO. 4

August 1, 1972 to December 31, 1975:

Existing wood waste burners are exempt from Section 1.A and II.B of Regulation No. 1 and Regulation No. 4 shall apply.

August 1, 1972 to December 31, 1972:

Existing wood waste burners need a valid conditional permit to operate.

January 1, 1973 to December 31, 1975:

Burners must meet 20% opacity except for start-up time and three minutes in any one hour, unless the owner chooses to cease burning.

January 1, 1973:

If an owner chooses to cease burning, but cannot by this date, he may apply to the Variance Board for additional "reasonable" time, not to exceed one year.

September, 1972:

Joint meetings with the Commission and Variance Board

January 1, 1976:

Regulation No. 4 terminates.

STATEMENT OF POLICY TO THE AIR POLLUTION CONTROL DIVISION ON EXISTING WIGWAM WASTE BURNERS

To ease the administrative burden of granting individual conditional permits and possible field inspections prior to the granting of conditional permits, as required in Regulation No. 4, permit granting guidelines may be developed by the Division in conjunction with the Commission. These guidelines should meet the requirements of Section C.1 of Regulation No. 4, and should be developed by considering decisions of the Variance Board affecting wigwam waste burners and by meeting with a representative sample of the industry affected by this regulation. These guidelines should be available for the permit applicants by July 1, 1972 for use in preparing their permit applications.

After January 1, 1973, when Section D of Regulation No. 4 becomes effective, the Division may allow an owner or operator of a burner an exception above the 20% opacity requirement, but only during adverse operating conditions; such as, severe weather, and only if the burning meets the 20% opacity requirement most of the time and only if best practical controls have been installed, properly operated and maintained.

The Division shall encourage all owners or operators contemplating cessation under Section G of Regulation No. 4, to complete such plans prior to the joint meeting of the Commission and the Variance Board scheduled for September, 1972.

STATEMENT OF POLICY TO THE
COLORADO AIR POLLUTION VARIANCE BOARD
ON
EXISTING WIGWAM WASTE BURNERS

This Statement of Policy is to apply to the administration of Regulation No. 4 of the Commission regarding existing wigwam waste burners.

On May 8, 9, and 11, 1972, the Commission held public hearings on proposed Regulation No. 4 - "Emission Control Regulations for Wigwam Waste Burners." At these hearings, the wood products industry opposed the use of the 20% opacity requirement, but only under adverse operating conditions; such as, during cold weather and when wet material must be burned. Otherwise, the proposed regulation received favorable comment. Before adopting this regulation, the Commission considered some of the information presented to the Variance Board by the wood products industry, and in addition, contacted the State air pollution control programs of Arizona, Montana, New Mexico, Oregon, and Idaho regarding wigwam waste burners and their control. It is the conclusion of the Commission that Regulation No. 4 as adopted, takes into account the economical and technological achievability by the wood products industry, and is necessary to obtain better air quality in Colorado, considering the number of burners in operation.

One of the main considerations in adopting Regulation No. 4 was to avoid the necessity of having to cite each violation with subsequent hearings before the Variance Board. The Variance Board has consumed much of its time on wigwam waste burner hearings and the Commission intends, pursuant to Regulation No. 4, to allow time, through regulation, for burner owners or operators to design, construct, and make operational, adequate control systems.

THEREFORE, THE COMMISSION RESOLVES THAT IF AN OWNER OR OPERATOR OF A WIGWAM WASTE BURNER REQUESTS A VARIANCE FROM REGULATION NO. 4 AFTER JANUARY 1, 1973, SAID VARIANCE SHALL ONLY BE GRANTED FOR A SITUATION BEYOND THE REASONABLE PLANNING CAPABILITY OR THE CONTROL OF SAID OWNER OR OPERATOR.

The purpose of the joint meeting September, 1972 is for:

1) determining the progress that the owners or operators have made to meet the January 1, 1973 requirements on schedule,

2) determining whether the owners or operators are making a good faith effort to meet the requirements, and

3) determining the adequacy of Regulation No. 4 to achieve good air quality in the vicinity of wigwam waste burners.

REGULATION NO. 5

Emission Control Regulations for Existing Alfalfa Dehydration Plants

Colorado Air Pollution Control Commission

Adopted: June 8, 1972
Effective date: August 1, 1972

REGULATION NO. 5

Emission Control Regulations for Existing Alfalfa Dehydration Plants

A. Effective August 1, 1972 through April 30, 1973, all existing alfalfa dehydration plants shall be exempt from the provisions of Section I.A of Regulation No. 1 of the Commission and this Regulation No. 5, regarding alfalfa dehydration plants, shall apply instead. Commencing May 1, 1973, this Regulation No. 5 shall be terminated and Section I.A of Regulation No. 1 shall again become effective.

B. No owner or operator of any alfalfa dehydration plant shall cause or permit the use or operation of any existing air contamination source within that plant after August 1, 1972 without having a valid conditional permit to operate from the Division. This permit requirement shall remain effective through April 30, 1973.

   1. No conditional permit to operate shall be granted until the applicant has clearly stated in writing to the satisfaction of the Division, consistent with any guidelines developed by the Division, the optimum state of maintenance and the operating procedures for that source to operate so as to emit minimum air contaminants.

   2. Any failure to meet the terms and conditions of the conditional permit to operate shall invalidate the permit and a cease and desist order shall be issued.

C. During September of 1972 and March of 1973, the Division and each alfalfa dehydration plant owner or operator shall report, individually or cooperatively, before a joint meeting of the Commission and the Air Pollution Variance Board, the progress in meeting Section I.A of Regulation No. 1 of the Commission which becomes effective May 1, 1973.

STATEMENT OF POLICY TO THE
AIR POLLUTION CONTROL DIVISION
ON
EXISTING ALFALFA DEHYDRATION PLANTS

To ease the administrative burden of granting individual conditional permits and possible field inspections prior to granting of conditional permits as required in Regulation No. 5, permit granting guidelines may be developed by the Division in conjunction with the Commission. These guidelines should meet the requirements of Section B.1 of Regulation No. 5 and should be developed by meeting with a representative sample of the industry affected by this Regulation. These guidelines should be available for the permit applicants by July 1, 1972 for use in preparing their permit applications.

STATEMENT OF POLICY TO THE
COLORADO AIR POLLUTION VARIANCE BOARD
ON
EXISTING ALFALFA DEHYDRATION PLANTS

This Statement of Policy is to apply to the administration of Regulation No. 5 of the Commission regarding existing alfalfa dehydration plants.

On May 8, 9, and 11, 1972, the Commission held public hearings on proposed Regulation No. 5 - "Emission Control Regulations for Alfalfa Dehydration Plants." In addition to information the Commission received at hearings, other information on the control of emissions from these plants has been submitted to the Commission by the alfalfa dehydration industry and the Division. The alfalfa dehydration industry did not oppose the proposed Regulation No. 5 at these public hearings. It is the conclusion of the Commission that Regulation No. 5 as adopted, takes into account the economical and technological achievability by the alfalfa dehydration industry and is necessary in obtaining better air quality in Colorado.

In adopting Regulation No. 5, the Commission's action was based upon certain considerations which include:

1) allowing the industry to experiment with various air pollution control systems during the 1972 growing season and have adequate control systems installed by May of 1973 so as to comply with Regulation No. 5 on schedule, and

2) avoiding the necessity of having to cite each violation with subsequent hearings before the Variance Board.

THEREFORE, THE COMMISSION RESOLVES THAT IF AN OWNER OR OPERATOR OF AN ALFALFA DEHYDRATION PLANT REQUESTS A VARIANCE FROM REGULATION NO. 5 AFTER MAY 1, 1973, SAID VARIANCE SHALL ONLY BE GRANTED FOR A SITUATION BEYOND THE REASONABLE PLANNING CAPABILITY OR CONTROL OF SAID OWNER OR OPERATOR.

The purpose of the joint meetings September 1972 and March 1973 is for:

1) determining the progress that the owners or operators have made to meet the May 1, 1973 requirements on schedule,

2) determining whether the owners or operators are making a good faith effort to meet the requirements, and

3) determining the adequacy of Regulation No. 5 to achieve good air quality in the vicinity of alfalfa dehydration plants.

Regulation No.6

Standards of Performance for New Stationary Sources

Colorado Air Pollution Control Commission

Effective: May 1, 1973

REGULATION NO. 6

STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

The Standards of Performance for New Stationary Sources within the State of Colorado are set forth and published in Volume 36, Number 247, Part II of the Federal Register, dated December 23, 1971, with the following amendments and exceptions thereto:

(a) The word "Administrator" as used therein shall mean the Air Pollution Control Division of the Colorado Department of Health or its authorized representative.

(b) The words "Environmental Protection Agency" as used therein shall mean the Colorado Air Pollution Control Commission.

(c) Section numbered 60.10 contained therein shall be deleted in its entirety.

Title 40—PROTECTION OF ENVIRONMENT

Chapter I—Environmental Protection Agency

SUBCHAPTER C—AIR PROGRAMS

PART 60—STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

On August 17, 1971 (36 F.R. 15704) pursuant to section 111 of the Clean Air Act as amended, the Administrator proposed standards of performance for steam generators, portland cement plants, incinerators, nitric acid plants, and sulfuric acid plants. The proposed standards, applicable to sources the construction or modification of which was initiated after August 17, 1971, included emission limits for one or more of four pollutants (particulate matter, sulfur dioxide, nitrogen oxides, and sulfuric acid mist) for each source category. The proposal included requirements for performance testing, stack gas monitoring, record keeping and reporting, and procedures by which EPA will provide preconstruction review and determine the applicability of the standards to specific sources.

Interested parties were afforded an opportunity to participate in the rule making by submitting comments. A total of more than 200 interested parties, including Federal, State, and local agencies, citizens groups, and commercial and industrial organizations submitted comments. Following a review of the proposed regulations and consideration of the comments, the regulations, including the appendix, have been revised and are being promulgated today. The principal revisions are described below:

1. Particulate matter performance testing procedures have been revised to eliminate the requirement for impingers in the sampling train. Compliance will be based only on material collected in the dry filter and the probe preceding the filter. Emission limits have been adjusted as appropriate to reflect the change in test methods. The adjusted standards require the same degree of particulate control as the originally proposed standards.

2. Provisions have been added whereby alternative test methods can be used to determine compliance. Any person who proposes the use of an alternative method will be obliged to provide evidence that the alternative method is equivalent to the reference method.

3. The definition of modification, as it pertains to increases in production rate and changes of fuels, has been clarified. Increases in production rates up to design capacity will not be considered a modification nor will fuel switches if the equipment was originally designed to accommodate such fuels. These provisions will eliminate inequities where equipment had been put into partial operation prior to the proposal of the standards.

4. The definition of a new source was clarified to include construction which is completed within an organization as well as the more common situations where the facility is designed and constructed by a contractor.

5. The provisions regarding requests for EPA plan review and determination of construction or modification have been modified to emphasize that the submittal of such requests and attendant information is purely voluntary. Submittal of such a request will not bind the operator to supply further information; however, lack of sufficient information may prevent the Administrator from rendering an opinion. Further provisions have been added to the effect that information submitted voluntarily for such plan review or determination of applicability will be considered confidential, if the owner or operator requests such confidentiality.

6. Requirements for notifying the Administrator prior to commencing construction have been deleted. As proposed, the provision would have required notification prior to the signing of a contract for construction of a new source. Owners and operators still will be required to notify the Administrator 30 days prior to initial operation and to confirm the action within 15 days after startup.

7. Revisions were incoporated to permit compliance testing to be deferred up to 60 days after achieving the maximum production rate but no longer than 180 days after initial startup. The proposed regulation could have required testing within 60 days after startup but defined startup as the beginning of routine operation. Owners or operators will be required to notify the Administrator at least 10 days prior to compliance testing so that an EPA observer can be on hand. Procedures have been modified so that the equipment will have to be operated at maximum expected production rate, rather than rated capacity, during compliance tests.

8. The criteria for evaluating performance testing results have been simplified to eliminate the requirement that all values be within 35 percent of the average. Compliance will be based on the average of three repetitions conducted in the specified manner.

9. Provisions were added to require owners or operators of affected facilities to maintain records of compliance tests, monitoring equipment, pertinent analyses, feed rates, production rates, etc. for 2 years and to make such information available on request to the Administrator. Owners or operators will be required to summarize the recorded data daily and to convert recorded data into the applicable units of the standard.

10. Modifications were made to the visible emission standards for steam generators, cement plants, nitric acid plants, and sulfuric acid plants. The Ringelmann standards have been deleted; all limits will be based on opacity. In every case, the equivalent opacity will be at least as stringent as the proposed Ringelmann number. In addition, requirements have been altered for three of the source categories so that allowable emissions will be less than 10 percent opacity rather than 5 percent or less opacity. There were many comments that observers could not accurately evaluate emissions of 5 percent opacity. In addition, drafting errors in the proposed visible emission limits for cement kilns and steam generators were corrected. Steam generators will be limited to visible emissions not greater than 20 percent opacity and cement kilns to not greater than 10 percent opacity.

11. Specifications for monitoring devices were clarified, and directives for calibration were included. The instruments are to be calibrated at least once a day, or more often if specified by the manufacturer. Additional guidance on the selection and use of such instruments will be provided at a later date.

12. The requirement for sulfur dioxide monitoring at steam generators was deleted for those sources which will achieve the standard by burning low-sulfur fuel, provided that fuel analysis is conducted and recorded daily. American Society for Testing and Materials sampling techniques are specified for coal and fuel oil.

13. Provisions were added to the steam generator standards to cover those instances where mixed fuels are burned. Allowable emissions will be determined by prorating the heat input of each fuel, however, in the case of sulfur dioxide, the provisions allow operators the option of burning low-sulfur fuels (probably natural gas) as a means of compliance.

14. Steam generators fired with lignite have been exempted from the nitrogen oxides limit. The revision was made in view of the lack of information on some types of lignite burning. When more information is developed, nitrogen oxides standards may be extended to lignite fired steam generators.

15. A provision was added to make it explicit that the sulfuric acid plant standards will not apply to scavenger acid plants. As stated in the background document, APTD 0711, which was issued at the time the proposed standards were published, the standards were not meant to apply to such operations, e.g., where sulfuric acid plants are used primarily to control sulfur dioxide or other sulfur compounds which would otherwise be vented into the atmosphere.

16. The regulation has been revised to provide that all materials submitted pursuant to these regulations will be directed to EPA's Office of General Enforcement.

17. Several other technical changes have also been made. States and interested parties are urged to make a careful reading of these regulations.

As required by section 111 of the Act, the standards of performance promulgated herein "reflect the degree of emission reduction which (taking into account the cost of achieving such reduction) the Administrator determines has been adequately demonstrated". The standards of performance are based on stationary source testing conducted by the Environmental Protection Agency and/or contractors and on data derived from various other sources, including the available technical literature. In the comments on the proposed standards, many questions were raised as to costs and demonstrated capability of control systems to meet the standards. These comments have been evaluated and investigated, and it is the Administrator's judgment that emission control systems capable of meeting the standards have been adequately demonstrated and that the standards promulgated herein are achievable at reasonable costs.

The regulations establishing standards of performance for steam generators, incinerators, cement plants, nitric acid plants, and sulfuric acid plants are hereby promulgated effective on publication and apply to sources, the construction or modification of which was commenced after August 17, 1971.

Dated: December 16, 1971.

William D. Ruckelshaus,
Administrator,
Environmental Protection Agency.

A new Part 60 is added to Chapter I, Title 40, Code of Federal Regulations, as follows:

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60.2 Definitions.
60.3 Abbreviations.
60.4 Address.
60.5 Determination of construction or modification.
60.6 Review of plans.
60.7 Notification and recordkeeping.
60.8 Performance tests.
60.9 Availability of information.
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Subpart D—Standards of Performance for Fossil Fuel-Fired Steam Generators

60.40 Applicability and designation of affected facility.
60.41 Definitions.
60.42 Standard for particulate matter.
60.43 Standard for sulfur dioxide.
60.44 Standard for nitrogen oxides.
60.45 Emission and fuel monitoring.
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Subpart E—Standards of Performance for Incinerators

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60.51 Definitions.
60.52 Standard for particulate matter.
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60.54 Test methods and procedures.

Subpart F—Standards of Performance for Portland Cement Plants

60.60 Applicability and designation of affected facility.
60.61 Definitions.
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60.70 Applicability and designation of affected facility.
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Subpart H—Standards of Performance for Sulfuric Acid Plants

60.80 Applicability and designation of affected facility.
60.81 Definitions.
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60.82 Standard for sulfur dioxide.
60.83 Standard for acid mist.
60.84 Emission monitoring.
60.85 Test methods and procedures.

Appendix—Test Methods

Method 1—Sample and velocity traverses for stationary sources.
Method 2—Determination of stack gas velocity and volumetric flow rate (Type S pitot tube).
Method 3—Gas analysis for carbon dioxide, excess air, and dry molecular weight.
Method 4—Determination of moisture in stack gases.
Method 5—Determination of particulate emissions from stationary sources.
Method 6—Determination of sulfur dioxide emissions from stationary sources.
Method 7—Determination of nitrogen oxide emissions from stationary sources.
Method 8—Determination of sulfuric acid mist and sulfur dioxide emissions from stationary sources.
Method 9—Visual determination of the opacity of emissions from stationary sources.

Authority: The provisions of this Part 60 issued under sections 111, 114, Clean Air Act; Public Law 91–604, 84 Stat. 1713.

Subpart A—General Provisions

§ 60.1 Applicability.

The provisions of this part apply to the owner or operator of any stationary source, which contains an affected facility the construction or modification of which is commenced after the date of publication in this part of any proposed standard applicable to such facility.

§ 60.2 Definitions.

As used in this part, all terms not defined herein shall have the meaning given them in the Act:

(a) "Act" means the Clean Air Act (42 U.S.C. 1857 et seq., as amended by Public Law 91–604, 84 Stat. 1676).

(b) "Administrator" means the Administrator of the Environmental Protection Agency or his authorized representative.

(c) "Standard" means a standard of performance proposed or promulgated under this part.

(d) "Stationary source" means any building, structure, facility, or installation which emits or may emit any air pollutant.

(e) "Affected facility" means, with reference to a stationary source, any apparatus to which a standard is applicable.

(f) "Owner or operator" means any person who owns, leases, operates, controls, or supervises an affected facility or a stationary source of which an affected facility is a part.

(g) "Construction" means fabrication, erection, or installation of an affected facility.

(h) "Modification" means any physical change in, or change in the method of operation of, an affected facility which increases the amount of any air pollutant (to which a standard applies) emitted by such facility or which results in the emission of any air pollutant (to which a standard applies) not previously emitted, except that:

(1) Routine maintenance, repair, and replacement shall not be considered physical changes, and

(2) The following shall not be considered a change in the method of operation:

(i) An increase in the production rate, if such increase does not exceed the operating design capacity of the affected facility;

(ii) An increase in hours of operation;

(iii) Use of an alternative fuel or raw material if, prior to the date any standard under this part becomes applicable to such facility, as provided by § 60.1, the affected facility is designed to accommodate such alternative use.

(i) "Commenced" means that an owner or operator has undertaken a continuous program of construction or modification or that an owner or operator has entered into a binding agreement or contractual obligation to undertake and complete, within a reasonable time, a continuous program of construction or modification.

(j) "Opacity" means the degree to which emissions reduce the transmission of light and obscure the view of an object in the background.

(k) "Nitrogen oxides" means all oxides of nitrogen except nitrous oxide, as measured by test methods set forth in this part.

(l) "Standard of normal conditions" means 70° Fahrenheit (21.1° centigrade) and 29.92 in. Hg (760 mm. Hg).

(m) "Proportional sampling" means sampling at a rate that produces a constant ratio of sampling rate to stack gas flow rate.

(n) "Isokinetic sampling" means sampling in which the linear velocity of the gas entering the sampling nozzle is equal to that of the undisturbed gas stream at the sample point.

(o) "Startup" means the setting in operation of an affected facility for any purpose.

§ 60.3 Abbreviations.

The abbreviations used in this part have the following meanings in both capital and lower case:

B.t.u.—British thermal unit.
cal.—calorie(s).
c.f.m.—cubic feet per minute.
CO_2—carbon dioxide.
g.—gram(s).
gr.—grain(s).
mg.—milligram(s).
mm.—millimeter(s).
l.—liter(s).
nm.—nanometer(s), —10^{-9} meter.
μg.—microgram(s), 10^{-6} gram.
Hg.—mercury.
in.—inch(es).
K—1,000.
lb.—pound(s).
ml.—milliliter(s).
No.—number.
%—percent.
NO—nitric oxide.
NO_2—nitrogen dioxide.
NO_x—nitrogen oxides.
$NM.^3$—normal cubic meter.
s.c.f.—standard cubic feet.
SO_2—sulfur dioxide.
H_2SO_4—sulfuric acid.
SO_3—sulfur trioxide.

ft.^{3}—cubic feet.
ft.^{2}—square feet.
min.—minute(s).
hr.—hour(s).

§ 60.4 Address.

All applications, requests, submissions, and reports under this part shall be submitted in triplicate and addressed to the Environmental Protection Agency, Office of General Enforcement, Waterside Mall SW., Washington, DC 20460.

§ 60.5 Determination of construction or modification.

When requested to do so by an owner or operator, the Administrator will make a determination of whether actions taken or intended to be taken by such owner or operator constitute construction or modification or the commencement thereof within the meaning of this part.

§ 60.6 Review of plans.

(a) When requested to do so by an owner or operator, the Administrator will review plans for construction or modification for the purpose of providing technical advice to the owner or operator.

(b) (1) A separate request shall be submitted for each affected facility.

(2) Each request shall (i) identify the location of such affected facility, and (ii) be accompanied by technical information describing the proposed nature, size, design, and method of operation of such facility, including information on any equipment to be used for measurement or control of emissions.

(c) Neither a request for plans review nor advice furnished by the Administrator in response to such request shall (1) relieve an owner or operator of legal responsibility for compliance with any provision of this part or of any applicable State or local requirement, or (2) prevent the Administrator from implementing or enforcing any provision of this part or taking any other action authorized by the Act.

§ 60.7 Notification and record keeping.

(a) Any owner or operator subject to the provisions of this part shall furnish the Administrator written notification as follows:

(1) A notification of the anticipated date of initial startup of an affected facility not more than 60 days or less than 30 days prior to such date.

(2) A notification of the actual date of initial startup of an affected facility within 15 days after such date.

(b) Any owner or operator subject to the provisions of this part shall maintain for a period of 2 years a record of the occurrence and duration of any startup, shutdown, or malfunction in operation of any affected facility.

§ 60.8 Performance tests.

(a) Within 60 days after achieving the maximum production rate at which the affected facility will be operated, but not later than 180 days after initial startup of such facility and at such other times as may be required by the Administrator under section 111 of the Act, the owner or operator of such facility shall conduct performance test(s) and furnish the Administrator a written report of the results of such performance test(s).

(b) Performance tests shall be conducted and results reported in accordance with the test method set forth in this part or equivalent methods approved by the Administrator; or where the Administrator determines that emissions from the affected facility are not susceptible of being measured by such methods, the Administrator shall prescribe alternative test procedures for determining compliance with the requirements of this part.

(c) The owner or operator shall permit the Administrator to conduct performance tests at any reasonable time, shall cause the affected facility to be operated for purposes of such tests under such conditions as the Administrator shall specify based on representative performance of the affected facility, and shall make available to the Administrator such records as may be necessary to determine such performance.

(d) The owner or operator of an affected facility shall provide the Administrator 10 days prior notice of the performance test to afford the Administrator the opportunity to have an observer present.

(e) The owner or operator of an affected facility shall provide, or cause to be provided, performance testing facilities as follows:

(1) Sampling ports adequate for test methods applicable to such facility.

(2) Safe sampling platform(s).

(3) Safe access to sampling platform(s).

(4) Utilities for sampling and testing equipment.

(f) Each performance test shall consist of three repetitions of the applicable test method. For the purpose of determining compliance with an applicable standard of performance, the average of results of all repetitions shall apply.

§ 60.9 Availability of information.

(a) Emission data provided to, or otherwise obtained by, the Administrator in accordance with the provisions of this part shall be available to the public.

(b) Except as provided in paragraph (a) of this section, any records, reports, or information provided to, or otherwise obtained by, the Administrator in accordance with the provisions of this part shall be available to the public, except that (1) upon a showing satisfactory to the Administrator by any person that such records, reports, or information, or particular part thereof (other than emission data), if made public, would divulge methods or processes entitled to protection as trade secrets of such person, the Administrator shall consider such records, reports, or information, or particular part thereof, confidential in accordance with the purposes of section 1905 of title 18 of the United States Code, except that such records, reports, or information, or particular part thereof, may be disclosed to other officers, employees, or authorized representatives of the United States concerned with carrying out the provisions of the Act or when relevant in any proceeding under the Act; and (2) information received by the Administrator solely for the purposes of §§ 60.5 and 60.6 shall not be disclosed if it is identified by the owner or operator as being a trade secret or commercial or financial information which such owner or operator considers confidential.

Subpart D—Standards of Performance for Fossil-Fuel Fired Steam Generators

§ 60.10 Applicability and designation of affected facility.

The provisions of this subpart are applicable to each fossil fuel-fired steam generating unit of more than 250 million B.t.u. per hour heat input, which is the affected facility.

§ 60.11 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act, and in Subpart A of this part.

(a) "Fossil fuel-fired steam generating unit" means a furnace or boiler used in the process of burning fossil fuel for the primary purpose of producing steam by heat transfer.

(b) "Fossil fuel" means natural gas, petroleum, coal and any form of solid, liquid, or gaseous fuel derived from such materials.

(c) "Particulate matter" means any finely divided liquid or solid material, other than uncombined water, as measured by Method 5.

§ 60.12 Standard for particulate matter.

On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of particulate matter which is:

(a) In excess of 0.10 lb. per million B.t.u. heat input (0.18 g. per million cal.) maximum 2-hour average.

(b) Greater than 20 percent opacity, except that 40 percent opacity shall be permissible for not more than 2 minutes in any hour.

(c) Where the presence of uncombined water is the only reason for failure to meet the requirements of paragraph (b) of this section such failure shall not be a violation of this section.

§ 60.43 Standard for sulfur dioxide.

On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of sulfur dioxide in excess of:

(a) 0.80 lb. per million B.t.u. heat input (1.4 g. per million cal.), maximum 2-hour average, when liquid fossil fuel is burned.

(b) 1.2 lbs. per million B.t.u. heat input (2.2 g. per million cal.), maximum 2-hour average, when solid fossil fuel is burned.

(c) Where different fossil fuels are burned simultaneously in any combination, the applicable standard shall be determined by proration. Compliance shall be determined using the following formula:

$$\frac{y(0.80)+z(1.2)}{x+y+z}$$

where:

x is the percent of total heat input derived from gaseous fossil fuel and,
y is the percent of total heat input derived from liquid fossil fuel and,
z is the percent of total heat input derived from solid fossil fuel.

§ 60.44 Standard for nitrogen oxides.

On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of nitrogen oxides in excess of:

(a) 0.20 lb. per million B.t.u. heat input (0.36 g. per million cal.), maximum 2-hour average, expressed as NO_2, when gaseous fossil fuel is burned.

(b) 0.30 lb. per million B.t.u. heat input (0.54 g. per million cal.), maximum 2-hour average, expressed as NO_2, when liquid fossil fuel is burned.

(c) 0.70 lb. per million B.t.u. heat input (1.26 g. per million cal.), maximum 2-hour average, expressed as NO_2 when solid fossil fuel (except lignite) is burned.

(d) When different fossil fuels are burned simultaneously in any combination the applicable standard shall be determined by proration. Compliance shall be determined by using the following formula:

$$\frac{x(0.20)+y(0.30)+z(0.70)}{x+y+z}$$

where:

x is the percent of total heat input derived from gaseous fossil fuel and,
y is the percent of total heat input derived from liquid fossil fuel and,
z is the percent of total heat input derived from solid fossil fuel.

§ 60.45 Emission and fuel monitoring.

(a) There shall be installed, calibrated, maintained, and operated, in any fossil fuel-fired steam generating unit subject to the provisions of this part, emission monitoring instruments as follows:

(1) A photoelectric or other type smoke detector and recorder, except where gaseous fuel is the only fuel burned.

(2) An instrument for continuously monitoring and recording sulfur dioxide emissions, except where gaseous fuel is the only fuel burned, or where compliance is achieved through low sulfur fuels and representative sulfur analysis of fuels are conducted daily in accordance with paragraph (c) or (d) of this section.

(3) An instrument for continuously monitoring and recording emissions of nitrogen oxides.

(b) Instruments and sampling systems installed and used pursuant to this section shall be capable of monitoring emission levels within ±20 percent with a confidence level of 95 percent and shall be calibrated in accordance with the method(s) prescribed by the manufacturer(s) of such instruments; instruments shall be subjected to manufacturers recommended zero adjustment and calibration procedures at least once per 24-hour operating period unless the manufacturer(s) specifies or recommends calibration at shorter intervals, in which case such specifications or recommendations shall be followed. The applicable method specified in the appendix of this part shall be the reference method.

(c) The sulfur content of solid fuels, as burned, shall be determined in accordance with the following methods of the American Society for Testing and Materials.

(1) Mechanical sampling by Method D 2234065.

(2) Sample preparation by Method D 2013–65.

(3) Sample analysis by Method D 271–68.

(d) The sulfur content of liquid fuels, as burned, shall be determined in accordance with the American Society for Testing and Materials Methods D 1551–68, or D 129–64, or D 1552–64.

(e) The rate of fuel burned for each fuel shall be measured daily or at shorter intervals and recorded. The heating value and ash content of fuels shall be ascertained at least once per week and recorded. Where the steam generating unit is used to generate electricity, the average electrical output and the minimum and maximum hourly generation rate shall be measured and recorded daily.

(f) The owner or operator of any fossil fuel-fired steam generating unit subject to the provisions of this part shall maintain a file of all measurements required by this part. Appropriate measurements shall be reduced to the units of the applicable standard daily, and summarized monthly. The record of any such measurement(s) and summary shall be retained for at least 2 years following the date of such measurements and summaries.

§ 60.46 Test methods and procedures.

(a) The provisions of this section are applicable to performance tests for determining emissions of particulate matter, sulfur dioxide, and nitrogen oxides from fossil fuel-fired steam generating units.

(b) All performance tests shall be conducted while the affected facility is operating at or above the maximum steam production rate at which such facility will be operated and while fuels or combinations of fuels representative of normal operation are being burned and under such other relevant conditions as the Administrator shall specify based on representative performance of the affected facility.

(c) Test methods set forth in the appendix to this part or equivalent methods approved by the Administrator shall be used as follows:

(1) For each repetition, the average concentration of particulate matter shall be determined by using Method 5. Traversing during sampling by Method 5 shall be according to Method 1. The minimum sampling time shall be 2 hours, and minimum sampling volume shall be 60 ft.^{3} corrected to standard conditions on a dry basis.

(2) For each repetition, the SO_2 concentration shall be determined by using Method 6. The sampling site shall be the same as for determining volumetric flow rate. The sampling point in the duct shall be at the centroid of the cross section if the cross sectional area is less than 50 ft.^{2} or at a point no closer to the walls than 3 feet if the cross sectional area is 50 ft.^{2} or more. The sample shall be extracted at a rate proportional to the gas velocity at the sampling point. The minimum sampling time shall be 20 min. and minimum sampling volume shall be 0.75 ft.^{3} corrected to standard conditions. Two samples shall constitute one repetition and shall be taken at 1-hour intervals.

(3) For each repetition the NO_x concentration shall be determined by using Method 7. The sampling site and point shall be the same as for SO_2. The sampling time shall be 2 hours, and four samples shall be taken at 30-minute intervals.

(4) The volumetric flow rate of the total effluent shall be determined by using Method 2 and traversing according to Method 1. Gas analysis shall be performed by Method 3, and moisture content shall be determined by the condenser technique of Method 5.

(d) Heat input, expressed in B.t.u. per hour, shall be determined during each 2-hour testing period by suitable fuel flow meters and shall be confirmed by a material balance over the steam generation system.

(e) For each repetition, emissions, expressed in lb./10^6 B.t.u. shall be determined by dividing the emission rate in lb./hr. by the heat input. The emission rate shall be determined by the equation, lb./hr. $= Q_s \times c$ where, $Q_s =$ volumetric flow rate of the total effluent in ft.^{3}/hr. at standard conditions, dry basis, as determined in accordance with paragraph (c)(4) of this section.

(1) For particulate matter, c = particulate concentration in lb./ft.^{3}, at determined in accordance with paragraph (c)(1) of this section, corrected to standard conditions, dry basis.

(2) For SO_2, $c = SO_2$ concentration in lb./ft.^{3}, as determined in accordance with paragraph (c)(2) of this section, corrected to standard conditions, dry basis.

(3) For NO_x, $c = NO_x$ concentration in lb./ft.^{3}, as determined in accordance with paragraph (c)(3) of this section, corrected to standard conditions, dry basis.

Subpart E—Standards of Performance for Incinerators

§ 60.50 Applicability and designation of affected facility.

The provisions of this subpart are applicable to each incinerator of more than 50 tons per day charging rate, which is the affected facility.

§ 60.51 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Incinerator" means any furnace used in the process of burning solid waste for the primary purpose of reducing the volume of the waste by removing combustible matter.

(b) "Solid waste" means refuse, more than 50 percent of which is municipal type waste consisting of a mixture of paper, wood, yard wastes, food wastes, plastics, leather, rubber, and other combustibles, and noncombustible materials such as glass and rock.

(c) "Day" means 24 hours.

(d) "Particulate matter" means any finely divided liquid or solid material, other than uncombined water, as measured by Method 5.

§ 60.52 Standard for particulate matter.

On and after the date on which the performance test required to be conducted by § 60.8 is initiated, no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of particulate matter which is in excess of 0.08 gr./s.c.f. (0.18 g./NM^3) corrected to 12 percent CO_2, maximum 2-hour average.

§ 60.53 Monitoring of operations.

The owner or operator of any incinerator subject to the provisions of this part shall maintain a file of daily burning rates and hours of operation and any particulate emission measurements. The burning rates and hours of operation shall be summarized monthly. The record(s) and summary shall be retained for at least 2 years following the date of such records and summaries.

§ 60.54 Test methods and procedures.

(a) The provisions of this section are applicable to performance tests for determining emissions of particulate matter from incinerators.

(b) All performance tests shall be conducted while the affected facility is operating at or above the maximum refuse charging rate at which such facility will be operated and the solid waste burned shall be representative of normal operation and under such other relevant conditions as the Administrator shall specify based on representative performance of the affected facility.

(c) Test methods set forth in the appendix to this part or equivalent methods approved by the Administrator shall be used as follows:

(1) For each repetition, the average concentration of particulate matter shall be determined by using Method 5. Traversing during sampling by Method 5 shall be according to Method 1. The minimum sampling time shall be 2 hours and the minimum sampling volume shall be 60 ft.^{3} corrected to standard conditions on a dry basis.

(2) Gas analysis shall be performed using the integrated sample technique of Method 3, and moisture content shall be determined by the condenser technique of Method 5. If a wet scrubber is used, the gas analysis sample shall reflect flue gas conditions after the scrubber, allowing for the effect of carbon dioxide absorption.

(d) For each repetition particulate matter emissions, expressed in gr./s.c.f., shall be determined in accordance with paragraph (c)(1) of this section corrected to 12 percent CO_2, dry basis.

Subpart F—Standards of Performance for Portland Cement Plants

§ 60.60 Applicability and designation of affected facility.

The provisions of the subpart are applicable to the following affected facilities in portland cement plants: kiln, clinker cooler, raw mill system, finish mill system, raw mill dryer, raw material storage, clinker storage, finished product storage, conveyor transfer points, bagging and bulk loading and unloading systems.

§ 60.61 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Portland cement plant" means any facility manufacturing portland cement by either the wet or dry process.

(b) "Particulate matter" means any finely divided liquid or solid material, other than uncombined water, as measured by Method 5.

§ 60.62 Standard for particulate matter.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of particulate matter from the kiln which is:

(1) In excess of 0.30 lb. per ton of feed to the kiln (0.15 Kg. per metric ton), maximum 2-hour average.

(2) Greater than 10 percent opacity, except that where the presence of uncombined water is the only reason for failure to meet the requirements for this subparagraph, such failure shall not be a violation of this section.

(b) On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of particulate matter from the clinker cooler which is:

(1) In excess of 0.10 lb. per ton of feed to the kiln (0.050 Kg. per metric ton) maximum 2-hour average.

(2) 10 percent opacity or greater.

(c) On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of particulate matter from any affected facility other than the kiln and clinker cooler which is 10 percent opacity or greater.

§ 60.63 Monitoring of operations.

The owner or operator of any portland cement plant subject to the provisions of this part shall maintain a file of daily production rates and kiln feed rates and any particulate emission measurements. The production and feed rates shall be summarized monthly. The record(s) and summary shall be retained for at least 2 years following the date of such records and summaries.

§ 60.64 Test methods and procedures.

(a) The provisions of this section are applicable to performance tests for determining emissions of particulate matter from portland cement plant kilns and clinker coolers.

(b) All performance tests shall be conducted while the affected facility is operating at or above the maximum production rate at which such facility will be operated and under such other relevant conditions as the Administrator shall specify based on representative performance of the affected facility.

(c) Test methods set forth in the appendix to this part or equivalent methods approved by the Administrator shall be used as follows:

(1) For each repetition, the average concentration of particulate matter shall be determined by using Method 5. Traversing during sampling by Method 5 shall be according to Method 1. The minimum sampling time shall be 2 hours and the minimum sampling volume shall be 60 ft.^{3} corrected to standard conditions on a dry basis.

(2) The volumetric flow rate of the total effluent shall be determined by using Method 2 and traversing according to Method 1. Gas analysis shall be performed using the integrated sample technique of Method 3, and moisture content shall be determined by the condenser technique of Method 5.

(d) Total kiln feed (except fuels), expressed in tons per hour on a dry basis, shall be determined during each 2-hour testing period by suitable flow meters and shall be confirmed by a material balance over the production system.

(e) For each repetition, particulate matter emissions, expressed in lb./ton of kiln feed shall be determined by dividing the emission rate in lb./hr. by the kiln feed. The emission rate shall be determined by the equation, $\text{lb./hr.} = Q_s \times c$, where Q_s=volumetric flow rate of the total effluent in ft.^{3}/hr. at standard conditions, dry basis, as determined in accordance with paragraph (c)(2) of this section, and, c=particulate concentration in lb./ft.^{3}, as determined in accordance with paragraph (c)(1) of this section, corrected to standard conditions, dry basis.

Subpart G—Standards of Performance for Nitric Acid Plants

§ 60.70 Applicability and designation of affected facility.

The provisions of this subpart are applicable to each nitric acid production unit, which is the affected facility.

§ 60.71 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Nitric acid production unit" means any facility producing weak nitric acid by either the pressure or atmospheric pressure process.

(b) "Weak nitric acid" means acid which is 30 to 70 percent in strength.

§ 60.72 Standard for nitrogen oxides.

On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of nitrogen oxides which are:

(a) In excess of 3 lbs. per ton of acid produced (1.5 kg. per metric ton), maximum 2-hour average, expressed as NO$_2$.

(b) 10 percent opacity or greater.

§ 60.73 Emission monitoring.

(a) There shall be installed, calibrated, maintained, and operated, in any nitric acid production unit subject to the provisions of this subpart, an instrument for continuously monitoring and recording emissions of nitrogen oxides.

(b) The instrument and sampling system installed and used pursuant to this section shall be capable of monitoring emission levels within ±20 percent with a confidence level of 95 percent and shall be calibrated in accordance with the method(s) prescribed by the manufacturer(s) of such instrument, the instrument shall be subjected to manufacturers recommended zero adjustment and calibration procedures at least once per 24-hour operating period unless the manufacturer(s) specifies or recommends calibration at shorter intervals, in which case such specifications or recommendations shall be followed. The applicable method specified in the appendix of this part shall be the reference method.

(c) Production rate and hours of operation shall be recorded daily.

(d) The owner or operator of any nitric acid production unit subject to the provisions of this part shall maintain a file of all measurements required by this subpart. Appropriate measurements shall be reduced to the units of the standard daily and summarized monthly. The record of any such measurement and summary shall be retained for at least 2 years following the date of such measurements and summaries.

§ 60.74 Test methods and procedures.

(a) The provisions of this section are applicable to performance tests for determining emissions of nitrogen oxides from nitric acid production units.

(b) All performance tests shall be conducted while the affected facility is operating at or above the maximum acid production rate at which such facility will be operated and under such other relevant conditions as the Administrator shall specify based on representative performance of the affected facility.

(c) Test methods set forth in the appendix to this part or equivalent methods as approved by the Administrator shall be used as follows:

(1) For each repetition the NO$_x$ concentration shall be determined by using Method 7. The sampling site shall be selected according to Method 1 and the sampling point shall be the centroid of the stack or duct. The sampling time shall be 2 hours and four samples shall be taken at 30-minute intervals.

(2) The volumetric flow rate of the total effluent shall be determined by using Method 2 and traversing according to Method 1. Gas analysis shall be performed by using the integrated sample technique of Method 3, and moisture content shall be determined by Method 4.

(d) Acid produced, expressed in tons per hour of 100 percent nitric acid, shall be determined during each 2-hour testing period by suitable flow meters and shall be confirmed by a material balance over the production system.

(e) For each repetition, nitrogen oxides emissions, expressed in lb./ton of 100 percent nitric acid, shall be determined by dividing the emission rate in lb./hr. by the acid produced. The emission rate shall be determined by the equation, lb./hr.=$Q_s \times c$, where Q_s=volumetric flow rate of the effluent in ft.^{3}/hr. at standard conditions, dry basis, as determined in accordance with paragraph (c)(2) of this section, and c=NO$_x$ concentration in lb./ft.^{3}, as determined in accordance with paragraph (c)(1) of this section, corrected to standard conditions, dry basis.

Subpart H—Standards of Performance for Sulfuric Acid Plants

§ 60.80 Applicability and designation of affected facility.

The provisions of this subpart are applicable to each sulfuric acid production unit, which is the affected facility.

§ 60.81 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Sulfuric acid production unit" means any facility producing sulfuric acid by the contact process by burning elemental sulfur, alkylation acid, hydrogen sulfide, organic sulfides and mercaptans, or acid sludge, but does not include facilities where conversion to sulfuric acid is utilized primarily as a means of preventing emissions to the atmosphere of sulfur dioxide or other sulfur compounds.

(b) "Acid mist" means sulfuric acid mist, as measured by test methods set forth in this part.

§ 60.82 Standard for sulfur dioxide.

On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of sulfur dioxide in excess of 4 lbs. per ton of acid produced (2 kg. per metric ton), maximum 2-hour average.

§ 60.83 Standard for acid mist.

On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of acid mist which is:

(a) In excess of 0.15 lb. per ton of acid produced (0.075 kg. per metric ton), maximum 2-hour average, expressed as H_2SO_4.

(b) 10 percent opacity or greater.

§ 60.84 Emission monitoring.

(a) There shall be installed, calibrated, maintained, and operated, in any sulfuric acid production unit subject to the provisions of this subpart, an instrument for continuously monitoring and recording emissions of sulfur dioxide.

(b) The instrument and sampling system installed and used pursuant to this section shall be capable of monitoring emission levels within ±20 percent with a confidence level of 95 percent and shall be calibrated in accordance with the method(s) prescribed by the manufacturer(s) of such instrument, the instrument shall be subject to manufacturers recommended zero adjustment calibration procedures at least once per 24-hour operating period unless the manufacturer(s) specified or recommends calibration at shorter intervals, in which case such specifications or recommendations shall be followed. The applicable method specified in the appendix of this part shall be the reference method.

(c) Production rate and hours of operation shall be recorded daily.

(d) The owner or operator of any sulfuric acid production unit subject to the provisions of this subpart shall maintain a file of all measurements required by this subpart. Appropriate measurements shall be reduced to the units of the applicable standard daily and summarized monthly. The record of any such measurement and summary shall be retained for at least 2 years following the date of such measurements and summaries.

§ 60.85 Test methods and procedures.

(a) The provisions of this section are applicable to performance tests for determining emissions of acid mist and sulfur dioxide from sulfuric acid production units.

(b) All performance tests shall be conducted while the affected facility is operating at or above the maximum acid production rate at which such facility will be operated and under such other relevant conditions as the Administrator shall specify based on representative performance of the affected facility.

(c) Test methods set forth in the appendix to this part or equivalent methods as approved by the Administrator shall be used as follows:

(1) For each repetition the acid mist and SO_2 concentrations shall be determined by using Method 8 and traversing according to Method 1. The minimum sampling time shall be 2 hours, and minimum sampling volume shall be 40 ft.³ corrected to standard conditions.

(2) The volumetric flow rate of the total effluent shall be determined by using Method 2 and traversing according to Method 1. Gas analysis shall be performed by using the integrated sample technique of Method 3. Moisture content can be considered to be zero.

(d) Acid produced, expressed in tons per hour of 100 percent sulfuric acid shall be determined during each 2-hour testing period by suitable flow meters and shall be confirmed by a material balance over the production system.

(e) For each repetition acid mist and sulfur dioxide emissions, expressed in lb./ton of 100 percent sulfuric acid shall be determined by dividing the emission rate in lb./hr. by the acid produced. The emission rate shall be determined by the equation, lb./hr.$=Q_s \times c$, where Q_s=volumetric flow rate of the effluent in ft.³/hr. at standard conditions, dry basis as determined in accordance with paragraph (c)(2) of this section, and c=acid mist and SO_2 concentrations in lb./ft.³ as determined in accordance with paragraph (c)(1) of this section, corrected to standard conditions, dry basis.

APPENDIX—TEST METHODS

METHOD 1—SAMPLE AND VELOCITY TRAVERSES FOR STATIONARY SOURCES

1. *Principle and Applicability.*

1.1 Principle. A sampling site and the number of traverse points are selected to aid in the extraction of a representative sample.

1.2 Applicability. This method should be applied only when specified by the test procedures for determining compliance with the New Source Performance Standards. Unless otherwise specified, this method is not intended to apply to gas streams other than those emitted directly to the atmosphere without further processing.

2. *Procedure.*

2.1 Selection of a sampling site and minimum number of traverse points.

2.1.1 Select a sampling site that is at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, contraction, or visible flame. For rectangular cross section, determine an equivalent diameter from the following equation:

$$\text{equivalent diameter}=2\left(\frac{(\text{length})(\text{width})}{\text{length}+\text{width}}\right)$$

equation 1-1

2.1.2 When the above sampling site criteria can be met, the minimum number of traverse points is twelve (12).

2.1.3 Some sampling situations render the above sampling site criteria impractical. When this is the case, choose a convenient sampling location and use Figure 1-1 to determine the minimum number of traverse points. Under no conditions should a sampling point be selected within 1 inch of the stack wall. To obtain the number of traverse points for stacks or ducts with a diameter less than 2 feet, multiply the number of points obtained from Figure 1-1 by 0.67.

2.1.4 To use Figure 1-1 first measure the distance from the chosen sampling location to the nearest upstream and downstream disturbances. Determine the corresponding number of traverse points for each distance from Figure 1-1. Select the higher of the two numbers of traverse points, or a greater value, such that for circular stacks the number is a multiple of 4, and for rectangular stacks the number follows the criteria of section 2.2.2.

2.2 Cross-sectional layout and location of traverse points.

2.2.1 For circular stacks locate the traverse points on at least two diameters according to Figure 1-2 and Table 1-1. The traverse axes shall divide the stack cross section into equal parts.

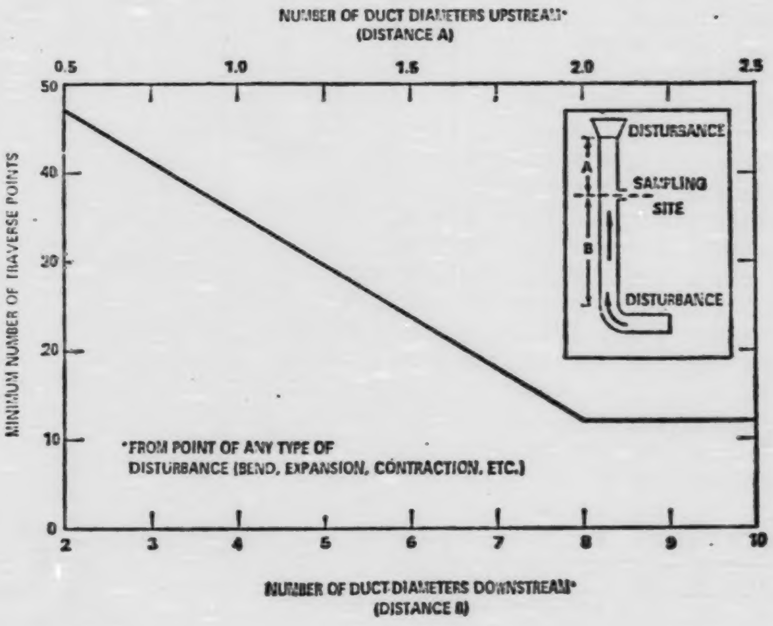

Figure 1-1. Minimum number of traverse points.

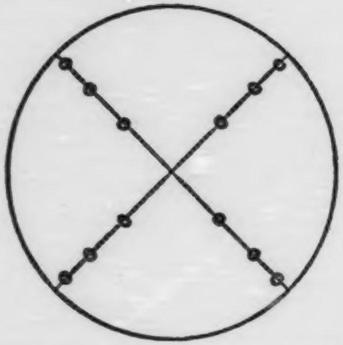

Figure 1-2. Cross section of circular stack divided into 12 equal areas, showing location of traverse points at centroid of each area.

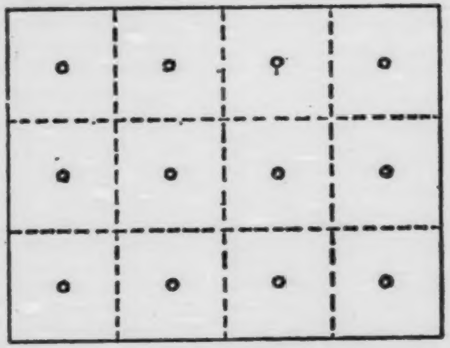

Figure 1-3. Cross section of rectangular stack divided into 12 equal areas, with traverse points at centroid of each area.

Table 1-1. Location of traverse points in circular stacks
(Percent of stack diameter from inside wall to traverse point)

Traverse point number on a diameter	Number of traverse points on a diameter											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.3	2.5	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.7	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.5	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.5	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.3	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.5	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.5	36.6	28.3	23.6	20.4	18.0	16.1
8				96.7	85.4	65.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.1	23.0
10					97.5	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.9	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

2.2.2 For rectangular stacks divide the cross section into as many equal rectangular areas as traverse points, such that the ratio of the length to the width of the elemental areas is between one and two. Locate the traverse points at the centroid of each equal area according to Figure 1-3.

3. *References.*

Determining Dust Concentration in a Gas Stream, ASME Performance Test Code #27, New York, N.Y., 1957.

Devorkin, Howard, et al., Air Pollution Source Testing Manual, Air Pollution Control District, Los Angeles, Calif. November 1963.

Methods for Determination of Velocity, Volume, Dust and Mist Content of Gases, Western Precipitation Division of Joy Manufacturing Co., Los Angeles, Calif. Bulletin WP-50, 1968.

Standard Method for Sampling Stacks for Particulate Matter, In: 1971 Book of ASTM Standards, Part 23, Philadelphia, Pa. 1971, ASTM Designation D-2928-71.

METHOD 2—DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE (TYPE S PITOT TUBE)

1. *Principle and applicability.*

1.1 Principle. Stack gas velocity is determined from the gas density and from measurement of the velocity head using a Type S (Stauscheibe or reverse type) pitot tube.

1.2 Applicability. This method should be applied only when specified by the test procedures for determining compliance with the New Source Performance Standards.

2. *Apparatus.*

2.1 Pitot tube—Type S (Figure 2-1), or equivalent, with a coefficient within ±5% over the working range.

2.2 Differential pressure gauge—Inclined manometer, or equivalent, to measure velocity head to within 10% of the minimum value.

2.3 Temperature gauge—Thermocouple or equivalent attached to the pitot tube to measure stack temperature to within 1.5% of the minimum absolute stack temperature.

2.4 Pressure gauge—Mercury-filled U-tube manometer, or equivalent, to measure stack pressure to within 0.1 in. Hg.

2.5 Barometer—To measure atmospheric pressure to within 0.1 in. Hg.

2.6 Gas analyzer—To analyze gas composition for determining molecular weight.

2.7 Pitot tube—Standard type, to calibrate Type S pitot tube.

3. *Procedure.*

3.1 Set up the apparatus as shown in Figure 2-1. Make sure all connections are tight and leak free. Measure the velocity head and temperature at the traverse points specified by Method 1.

3.2 Measure the static pressure in the stack.

3.3 Determine the stack gas molecular weight by gas analysis and appropriate calculations as indicated in Method 3.

4. *Calibration.*

4.1 To calibrate the pitot tube, measure the velocity head at some point in a flowing gas stream with both a Type S pitot tube and a standard type pitot tube with known coefficient. Calibration should be done in the laboratory and the velocity of the flowing gas stream should be varied over the normal working range. It is recommended that the calibration be repeated after use at each field site.

4.2 Calculate the pitot tube coefficient using equation 2-1.

$$C_{p_{test}}=C_{p_{std}}\sqrt{\frac{\Delta p_{std}}{\Delta p_{test}}} \quad \text{equation 2-1}$$

where:

$C_{p_{test}}$=Pitot tube coefficient of Type S pitot tube.

$C_{p_{std}}$=Pitot tube coefficient of standard type pitot tube (if unknown, use 0.99).

Δp_{std}= Velocity head measured by standard type pitot tube.

Δp_{test}= Velocity head measured by Type S pitot tube.

4.3 Compare the coefficients of the Type S pitot tube determined first with one leg and then the other pointed downstream. Use the pitot tube only if the two coefficients differ by no more than 0.01.

5. *Calculations.*

Use equation 2-2 to calculate the stack gas velocity.

$$(V_s)_{avg.}=K_pC_p(\sqrt{\Delta p})_{avg.}\sqrt{\frac{(T_s)_{avg.}}{P_sM_s}}$$

Equation 2-2

where:

$(V_s)_{avg.}$=Stack gas velocity, feet per second (f.p.s.).

$K_p=85.48\frac{\text{ft.}}{\text{sec.}}\left(\frac{\text{lb.}}{\text{lb. mole-°R}}\right)^{1/2}$ when these units are used.

C_p=Pitot tube coefficient, dimensionless.

$(T_s)_{avg.}$=Average absolute stack gas temperature, °R.

$(\sqrt{\Delta p})_{avg.}$=Average velocity head of stack gas, inches H_2O (see Fig. 2-2).

P_s=Absolute stack gas pressure, inches Hg.

M_s=Molecular weight of stack gas (wet basis), lb./lb.-mole.

$M_d(1-B_{wo})+18B_{wo}$

M_d=Dry molecular weight of stack gas (from Method 3).

B_{wo}=Proportion by volume of water vapor in the gas stream (from Method 4).

Figure 2-2 shows a sample recording sheet for velocity traverse data. Use the averages in the last two columns of Figure 2-2 to determine the average stack gas velocity from Equation 2-2.

Use Equation 2-3 to calculate the stack gas volumetric flow rate.

$$Q_s=3600\ (1-B_{wo})V_sA\left(\frac{T_{std}}{(T_s)_{avg.}}\right)\left(\frac{P_s}{P_{std}}\right)$$

Equation 2-3

where:

Q_s=Volumetric flow rate, dry basis, standard conditions, ft.³/hr.

A=Cross-sectional area of stack, ft.²

T_{std}=Absolute temperature at standard conditions, 530° R.

P_{std}=Absolute pressure at standard conditions, 29.92 inches Hg.

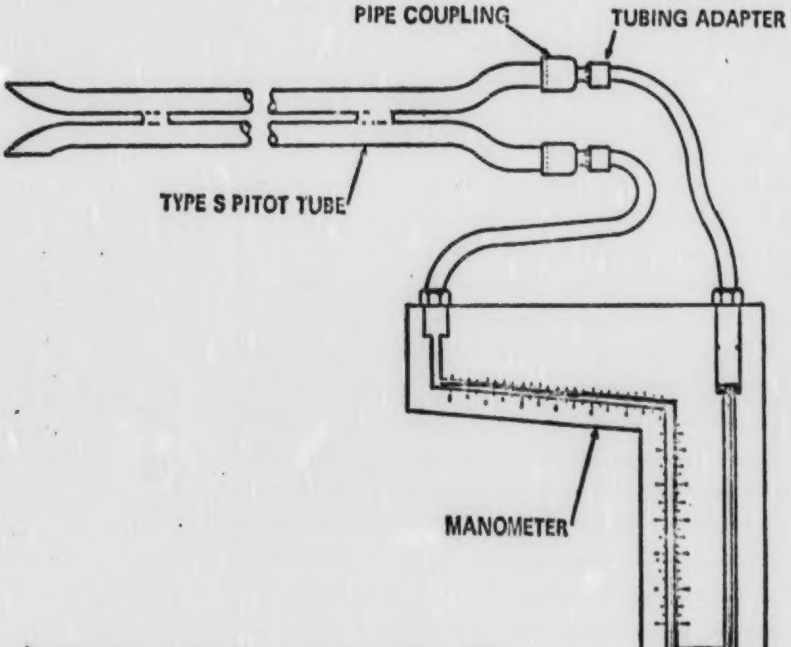

Figure 2-1. Pitot tube-manometer assembly.

6. *References.*

Mark, L. S., Mechanical Engineers' Handbook, McGraw-Hill Book Co., Inc., New York, N.Y., 1951.

Perry, J. H., Chemical Engineers' Handbook, McGraw-Hill Book Co., Inc., New York, N.Y., 1960.

Shigehara, R. T., W. F. Todd, and W. S. Smith, Significance of Errors in Stack Sampling Measurements. Paper presented at the Annual Meeting of the Air Pollution Control Association, St. Louis, Mo., June 14–19, 1970.

Standard Method for Sampling Stacks for Particulate Matter, In: 1971 Book of ASTM Standards, Part 23, Philadelphia, Pa., 1971, ASTM Designation D-2928-71.

Vennard, J. K., Elementary Fluid Mechanics, John Wiley & Sons, Inc., New York, N.Y., 1947.

PLANT__________________________

DATE__________________________

RUN NO.__________________________

STACK DIAMETER, in.__________________

BAROMETRIC PRESSURE, in. Hg.____________

STATIC PRESSURE IN STACK (P_g), in. Hg.________

OPERATORS__________________________

SCHEMATIC OF STACK CROSS SECTION

Traverse point number	Velocity head, in. H_2O	$\sqrt{\Delta p}$	Stack Temperature (T_S), °F
	AVERAGE:		

Figure 2-2. Velocity traverse data.

METHOD 3—GAS ANALYSIS FOR CARBON DIOXIDE, EXCESS AIR, AND DRY MOLECULAR WEIGHT

1. *Principle and applicability.*

1.1 Principle. An integrated or grab gas sample is extracted from a sampling point and analyzed for its components using an Orsat analyzer.

1.2 Applicability. This method should be applied only when specified by the test procedures for determining compliance with the New Source Performance Standards. The test procedure will indicate whether a grab sample or an integrated sample is to be used.

2. *Apparatus.*

2.1 Grab sample (Figure 3-1).

2.1.1 Probe—Stainless steel or Pyrex[1] glass, equipped with a filter to remove particulate matter.

2.1.2 Pump—One-way squeeze bulb, or equivalent, to transport gas sample to analyzer.

2.2 *Integrated sample (Figure 3-2).*

2.2.1 Probe—Stainless steel or Pyrex[1] glass, equipped with a filter to remove particulate matter.

2.2.2 Air-cooled condenser or equivalent—To remove any excess moisture.

2.2.3 Needle valve—To adjust flow rate.

2.2.4 Pump—Leak-free, diaphragm type, or equivalent, to pull gas.

2.2.5 Rate meter—To measure a flow range from 0 to 0.035 cfm.

2.2.6 Flexible bag—Tedlar,[1] or equivalent, with a capacity of 2 to 3 cu. ft. Leak test the bag in the laboratory before using.

2.2.7 Pitot tube—Type S, or equivalent, attached to the probe so that the sampling flow rate can be regulated proportional to the stack gas velocity when velocity is varying with time or a sample traverse is conducted.

2.3 *Analysis.*

2.3.1 Orsat analyzer, or equivalent.

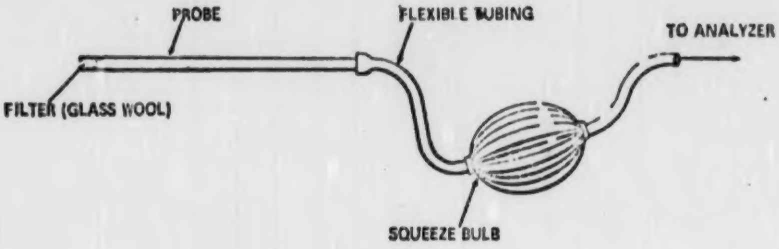

Figure 3-1. Grab-sampling train.

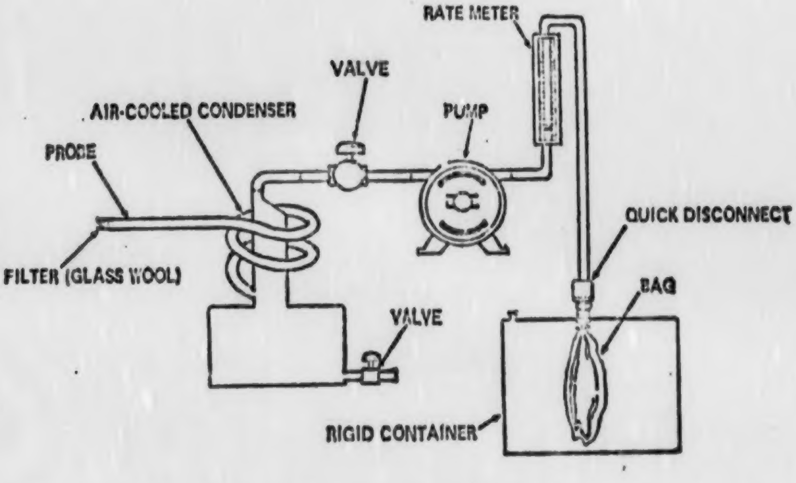

Figure 3-2. Integrated gas-sampling train.

3. *Procedure.*

3.1 Grab sampling.

3.1.1 Set up the equipment as shown in Figure 3-1, making sure all connections are leak-free. Place the probe in the stack at a sampling point and purge the sampling line.

3.1.2 Draw sample into the analyzer.

3.2 Integrated sampling.

3.2.1 Evacuate the flexible bag. Set up the equipment as shown in Figure 3-2 with the bag disconnected. Place the probe in the stack and purge the sampling line. Connect the bag, making sure that all connections are tight and that there are no leaks.

3.2.2 Sample at a rate proportional to the stack velocity.

3.3 Analysis.

3.3.1 Determine the CO_2, O_2, and CO concentrations as soon as possible. Make as many passes as are necessary to give constant readings. If more than ten passes are necessary, replace the absorbing solution.

3.3.2 For grab sampling, repeat the sampling and analysis until three consecutive samples vary no more than 0.5 percent by volume for each component being analyzed.

3.3.3 For integrated sampling, repeat the analysis of the sample until three consecutive analyses vary no more than 0.2 percent by volume for each component being analyzed.

4. *Calculations.*

4.1 Carbon dioxide. Average the three consecutive runs and report the result to the nearest 0.1% CO_2.

4.2 Excess air. Use Equation 3-1 to calculate excess air, and average the runs. Report the result to the nearest 0.1% excess air.

$$\%EA = \frac{(\%O_2) - 0.5(\%CO)}{0.264(\%N_2) - (\%O_2) + 0.5(\%CO)} \times 100$$

equation 3-1

where:

$\%EA$ = Percent excess air.

$\%O_2$ = Percent oxygen by volume, dry basis.

$\%N_2$ = Percent nitrogen by volume, dry basis.

$\%CO$ = Percent carbon monoxide by volume, dry basis.

0.264 = Ratio of oxygen to nitrogen in air by volume.

4.3 Dry molecular weight. Use Equation 3-2 to calculate dry molecular weight and average the runs. Report the result to the nearest tenth.

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$

equation 3-2

where:

M_d = Dry molecular weight, lb./lb-mole.

$\%CO_2$ = Percent carbon dioxide by volume, dry basis.

$\%O_2$ = Percent oxygen by volume, dry basis.

$\%N_2$ = Percent nitrogen by volume, dry basis.

0.44 = Molecular weight of carbon dioxide divided by 100.

0.32 = Molecular weight of oxygen divided by 100.

0.28 = Molecular weight of nitrogen and CO divided by 100.

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[1] Trade name.

5. *References.*

Altshuller, A. P., et al., Storage of Gases and Vapors in Plastic Bags, Int. J. Air & Water Pollution, 6:75–81, 1963.

Conner, William D., and J. S. Nader, Air Sampling with Plastic Bags, Journal of the American Industrial Hygiene Association, 25:291–297, May–June 1964.

Devorkin, Howard, et al., Air Pollution Source Testing Manual, Air Pollution Control District, Los Angeles, Calif., November 1963.

METHOD 4—DETERMINATION OF MOISTURE IN STACK GASES

1. *Principle and applicability.*

1.1 Principle. Moisture is removed from the gas stream, condensed, and determined volumetrically.

1.2 Applicability. This method is applicable for the determination of moisture in stack gas only when specified by test procedures for determining compliance with New Source Performance Standards. This method does not apply when liquid droplets are present in the gas stream[1] and the moisture is subsequently used in the determination of stack gas molecular weight.

Other methods such as drying tubes, wet bulb-dry bulb techniques, and volumetric condensation techniques may be used.

2. *Apparatus.*

2.1 Probe—Stainless steel or Pyrex[*] glass sufficiently heated to prevent condensation and equipped with a filter to remove particulate matter.

2.2 Impingers—Two midget impingers, each with 30 ml. capacity, or equivalent.

2.3 Ice bath container—To condense moisture in impingers.

2.4 Silica gel tube (optional)—To protect pump and dry gas meter.

2.5 Needle valve—To regulate gas flow rate.

2.6 Pump—Leak-free, diaphragm type, or equivalent, to pull gas through train.

2.7 Dry gas meter—To measure to within 1% of the total sample volume.

2.8 Rotameter—To measure a flow range from 0 to 0.1 c.f.m.

2.9 Graduated cylinder—25 ml.

2.10 Barometer—Sufficient to read to within 0.1 inch Hg.

2.11 Pitot tube—Type S, or equivalent, attached to probe so that the sampling flow rate can be regulated proportional to the stack gas velocity when velocity is varying with time or a sample traverse is conducted.

3. *Procedure.*

3.1 Place exactly 5 ml. distilled water in each impinger. Assemble the apparatus without the probe as shown in Figure 4–1. Leak check by plugging the inlet to the first impinger and drawing a vacuum. Insure that flow through the dry gas meter is less than 1% of the sampling rate.

3.2 Connect the probe and sample at a constant rate of 0.075 c.f.m. or at a rate proportional to the stack gas velocity. Continue sampling until the dry gas meter registers 1 cubic foot or until visible liquid droplets are carried over from the first impinger to the second. Record temperature, pressure, and dry gas meter readings as required by Figure 4–2.

3.3 After collecting the sample, measure the volume increase to the nearest 0.5 ml.

4. *Calculations.*

4.1 Volume of water vapor collected.

$$V_{wc}=\frac{(V_f-V_i)\rho_{H_2O}RT_{std}}{P_{std}M_{H_2O}}=0.0474\frac{\text{ft.}^3}{\text{ml.}}(V_f-V_i) \qquad \text{equation 4–1}$$

where:

V_{wc}=Volume of water vapor collected (standard conditions), cu. ft.

V_f=Final volume of impinger contents, ml.

V_i=Initial volume of impinger contents, ml.

R=Ideal gas constant, 21.83 inches Hg—cu. ft./lb. mole-°R.

ρ_{H_2O}=Density of water, 1 g./ml.

T_{std}=Absolute temperature at standard conditions, 530° R.

P_{std}=Absolute pressure at standard conditions, 29.92 inches Hg.

M_{H_2O}=Molecular weight of water, 18 lb./lb.-mole.

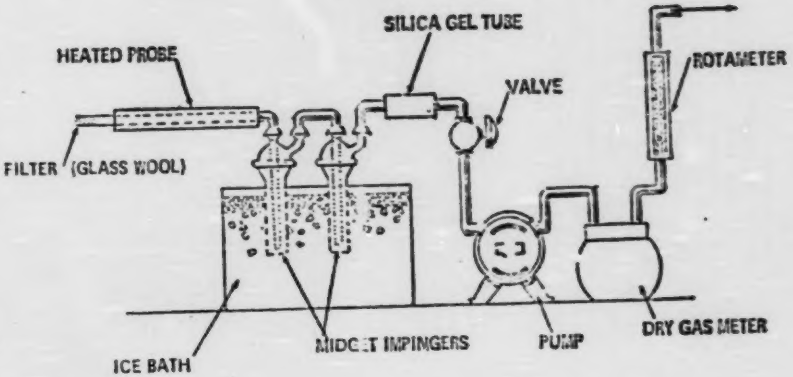

Figure 4-1. Moisture-sampling train.

LOCATION____________________ COMMENTS

TEST____________________

DATE____________________

OPERATOR____________________

BAROMETRIC PRESSURE____________________

CLOCK TIME	GAS VOLUME THROUGH METER, (Vm), ft³	ROTAMETER SETTING ft³/min	METER TEMPERATURE, °F

Figure 4-2. Field moisture determination.

---

[1] If liquid droplets are present in the gas stream, assume the stream to be saturated, determine the average stack gas temperature by traversing according to Method 1, and use a psychrometric chart to obtain an approximation of the moisture percentage.

[*] Trade name.

PLANT__________
LOCATION__________
OPERATOR__________
DATE__________
RUN NO.__________
SAMPLE BOX NO.__________
METER BOX NO.__________
METER ΔH@__________
C FACTOR__________

SCHEMATIC OF STACK CROSS SECTION

AMBIENT TEMPERATURE________
BAROMETRIC PRESSURE________
ASSUMED MOISTURE, %________
HEATER BOX SETTING________
PROBE LENGTH, m.________
NOZZLE DIAMETER, in.________
PROBE HEATER SETTING________

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (P_s), in. Hg	STACK TEMPERATURE (T_s), °F	VELOCITY HEAD (ΔP_s)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH), in. H_2O	GAS SAMPLE VOLUME (V_m), ft³	GAS SAMPLE TEMPERATURE AT DRY GAS METER		SAMPLE BOX TEMPERATURE, °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER, °F
							INLET ($T_{m_{in}}$), °F	OUTLET ($T_{m_{out}}$), °F		
TOTAL							Avg.	Avg.		
AVERAGE							Avg.			

Figure 5-2. Particulate field data.

4.2 Sample recovery. Exercise care in moving the collection train from the test site to the sample recovery area to minimize the loss of collected sample or the gain of extraneous particulate matter. Set aside a portion of the acetone used in the sample recovery as a blank for analysis. Measure the volume of water from the first three impingers, then discard. Place the samples in containers as follows:

Container No. 1. Remove the filter from its holder, place in this container, and seal.

Container No. 2. Place loose particulate matter and acetone washings from all sample-exposed surfaces prior to the filter in this container and seal. Use a razor blade, brush, or rubber policeman to lose adhering particles.

Container No. 3. Transfer the silica gel from the fourth impinger to the original container and seal. Use a rubber policeman as an aid in removing silica gel from the impinger.

4.3 Analysis. Record the data required on the example sheet shown in Figure 5-3. Handle each sample container as follows:

Container No. 1. Transfer the filter and any loose particulate matter from the sample container to a tared glass weighing dish, desiccate, and dry to a constant weight. Report results to the nearest 0.5 mg.

Container No. 2. Transfer the acetone washings to a tared beaker and evaporate to dryness at ambient temperature and pressure. Desiccate and dry to a constant weight. Report results to the nearest 0.5 mg.

Container No. 3. Weigh the spent silica gel and report to the nearest gram.

5. *Calibration.*

Use methods and equipment which have been approved by the Administrator to calibrate the orifice meter, pitot tube, dry gas meter, and probe heater. Recalibrate after each test series.

6. *Calculations.*

6.1 Average dry gas meter temperature and average orifice pressure drop. See data sheet (Figure 5-2).

6.2 Dry gas volume. Correct the sample volume measured by the dry gas meter to standard conditions (70° F., 29.92 inches Hg) by using Equation 5-1.

$$V_{m_{std}}=V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar}+\frac{\Delta H}{13.6}}{P_{std}}\right)=\left(17.71\,\frac{°\text{R}}{\text{in. Hg}}\right)V_m\left(\frac{P_{bar}+\frac{\Delta H}{13.6}}{T_m}\right)$$

equation 5-1

where:

$V_{m_{std}}$ = Volume of gas sample through the dry gas meter (standard conditions), cu. ft.
V_m = Volume of gas sample through the dry gas meter (meter conditions), cu. ft.
T_{std} = Absolute temperature at standard conditions, 530° R.
T_m = Average dry gas meter temperature, °R.
P_{bar} = Barometric pressure at the orifice meter, inches Hg.
ΔH = Average pressure drop across the orifice meter, inches H_2O.
13.6 = Specific gravity of mercury.
P_{std} = Absolute pressure at standard conditions, 29.92 inches Hg.

6.3 Volume of water vapor.

$$V_{w_{std}}=V_{l_c}\left(\frac{\rho_{H_2O}}{M_{H_2O}}\right)\left(\frac{RT_{std}}{P_{std}}\right)=\left(0.0474\,\frac{\text{cu. ft.}}{\text{ml.}}\right)V_{l_c}$$

equation 5-2

where:

$V_{w_{std}}$ = Volume of water vapor in the gas sample (standard conditions), cu. ft.
V_{l_c} = Total volume of liquid collected in impingers and silica gel (see Figure 5-3), ml.
ρ_{H_2O} = Density of water, 1 g./ml.
M_{H_2O} = Molecular weight of water, 18 lb./lb.-mole.
R = Ideal gas constant, 21.83 inches Hg—cu. ft./lb.-mole-°R.
T_{std} = Absolute temperature at standard conditions, 530° R.
P_{std} = Absolute pressure at standard conditions, 29.92 inches Hg.

6.4 Moisture content.

$$B_{wo}=\frac{V_{w_{std}}}{V_{m_{std}}+V_{w_{std}}}$$

equation 5-3

where:

B_{wo} = Proportion by volume of water vapor in the gas stream, dimensionless.
$V_{w_{std}}$ = Volume of water in the gas sample (standard conditions), cu. ft.
$V_{m_{std}}$ = Volume of gas sample through the dry gas meter (standard conditions), cu. ft.

6.5 Total particulate weight. Determine the total particulate catch from the sum of the weights on the analysis data sheet (Figure 5-3).

6.6 Concentration.

6.6.1 Concentration in gr./s.c.f.

$$c'_s=\left(0.0154\,\frac{\text{gr.}}{\text{mg.}}\right)\left(\frac{M_n}{V_{m_{std}}}\right)$$

equation 5-4

where:

c'_s = Concentration of particulate matter in stack gas, gr./s.c.f., dry basis.
M_n = Total amount of particulate matter collected, mg.
$V_{m_{std}}$ = Volume of gas sample through dry gas meter (standard conditions), cu. ft.

4.2 Gas volume.

$$V_{m_{std}}=V_m\left(\frac{P_m}{P_{std}}\right)\left(\frac{T_{std}}{T_m}\right)=17.71\,\frac{°R}{\text{in. Hg}}\left(\frac{V_mP_m}{T_m}\right)\qquad\text{equation 4-2}$$

where:

$V_{m_{std}}$ = Dry gas volume through meter at standard conditions, cu. ft.

V_m = Dry gas volume measured by meter, cu. ft.

P_m = Barometric pressure at the dry gas meter, inches Hg.

P_{std} = Pressure at standard conditions, 29.92 inches Hg.

T_{std} = Absolute temperature at standard conditions, 530° R.

T_m = Absolute temperature at meter (°F+460), °R.

4.3 Moisture content.

$$B_{wo}=\frac{V_{wc}}{V_{wc}+V_{m_{std}}}+B_{wm}=\frac{V_{wc}}{V_{wc}+V_{m_{std}}}+(0.025)\qquad\text{equation 4-3}$$

where:

B_{wo} = Proportion by volume of water vapor in the gas stream, dimensionless.

V_{wc} = Volume of water vapor collected (standard conditions), cu. ft.

$V_{m_{std}}$ = Dry gas volume through meter (standard conditions), cu. ft.

B_{wm} = Approximate volumetric proportion of water vapor in the gas stream leaving the impingers, 0.025.

5. *References.*

Air Pollution Engineering Manual, Danielson, J. A. (ed.), U.S. DHEW, PHS, National Center for Air Pollution Control, Cincinnati, Ohio, PHS Publication No. 999-AP-40, 1967.

Devorkin, Howard, et al., Air Pollution Source Testing Manual, Air Pollution Control District, Los Angeles, Calif., November 1963.

Methods for Determination of Velocity, Volume, Dust and Mist Content of Gases, Western Precipitation Division of Joy Manufacturing Co., Los Angeles, Calif., Bulletin WP-50, 1968.

METHOD 5—DETERMINATION OF PARTICULATE EMISSIONS FROM STATIONARY SOURCES

1. *Principle and applicability.*

1.1 Principle. Particulate matter is withdrawn isokinetically from the source and its weight is determined gravimetrically after removal of uncombined water.

1.2 Applicability. This method is applicable for the determination of particulate emissions from stationary sources only when specified by the test procedures for determining compliance with New Source Performance Standards.

2. *Apparatus.*

2.1 Sampling train. The design specifications of the particulate sampling train used by EPA (Figure 5-1) are described in APTD-0581. Commercial models of this train are available.

2.1.1 Nozzle—Stainless steel (316) with sharp, tapered leading edge.

2.1.2 Probe—Pyrex[1] glass with a heating system capable of maintaining a minimum gas temperature of 250° F. at the exit end during sampling to prevent condensation from occurring. When length limitations (greater than about 8 ft.) are encountered at temperatures less than 600° F., Incoloy 825[1], or equivalent, may be used. Probes for sampling gas streams at temperatures in excess of 600° F. must have been approved by the Administrator.

2.1.3 Pitot tube—Type S, or equivalent, attached to probe to monitor stack gas velocity.

2.1.4 Filter Holder—Pyrex[1] glass with heating system capable of maintaining minimum temperature of 225° F.

2.1.5 Impingers / Condenser—Four impingers connected in series with glass ball joint fittings. The first, third, and fourth impingers are of the Greenburg-Smith design, modified by replacing the tip with a ½-inch ID glass tube extending to one-half inch from the bottom of the flask. The second impinger is of the Greenburg-Smith design with the standard tip. A condenser may be used in place of the impingers provided that the moisture content of the stack gas can still be determined.

2.1.6 Metering system—Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 5° F., dry gas meter with 2% accuracy, and related equipment, or equivalent, as required to maintain an isokinetic sampling rate and to determine sample volume.

2.1.7 Barometer—To measure atmospheric pressure to ±0.1 inches Hg.

2.2 Sample recovery.

2.2.1 Probe brush—At least as long as probe.

2.2.2 Glass wash bottles—Two.

2.2.3 Glass sample storage containers.

2.2.4 Graduated cylinder—250 ml.

2.3 Analysis.

2.3.1 Glass weighing dishes.

2.3.2 Desiccator.

2.3.3 Analytical balance—To measure to ±0.1 mg.

2.3.4 Trip balance—300 g. capacity, to measure to ±0.05 g.

3. *Reagents.*

3.1 Sampling.

3.1.1 Filters—Glass fiber, MSA 1106 BH[1], or equivalent, numbered for identification and preweighed.

3.1.2 Silica gel—Indicating type, 6-16 mesh, dried at 175° C. (350° F.) for 2 hours.

3.1.3 Water.

3.1.4 Crushed ice.

3.2 Sample recovery.

3.2.1 Acetone—Reagent grade.

3.3 Analysis.

3.3.1 Water.

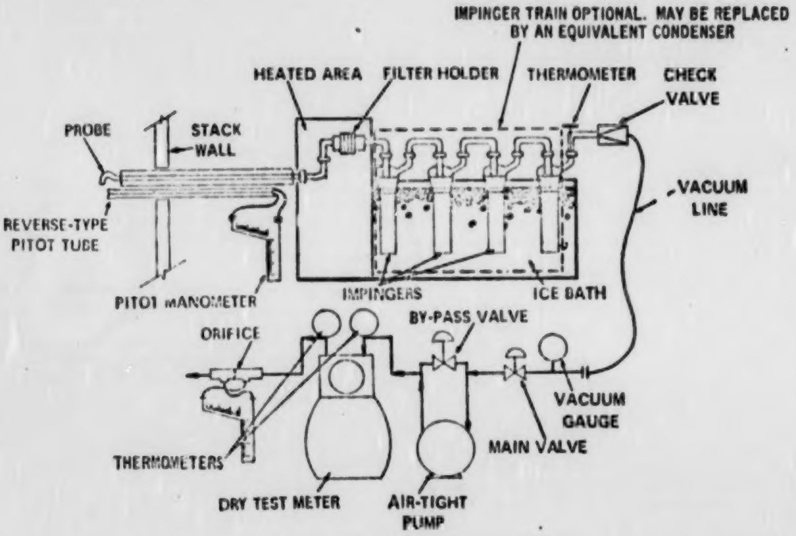

Figure 5-1. Particulate-sampling train.

3.3.2 Desiccant—Drierite,[1] indicating.

4. *Procedure.*

4.1 Sampling

4.1.1 After selecting the sampling site and the minimum number of sampling points, determine the stack pressure, temperature, moisture, and range of velocity head.

4.1.2 Preparation of collection train. Weigh to the nearest gram approximately 200 g. of silica gel. Label a filter of proper diameter, desiccate[2] for at least 24 hours and weigh to the nearest 0.5 mg. in a room where the relative humidity is less than 50%. Place 100 ml. of water in each of the first two impingers, leave the third impinger empty, and place approximately 200 g. of preweighed silica gel in the fourth impinger. Set up the train without the probe as in Figure 5-1. Leak check the sampling train at the sampling site by plugging up the inlet to the filter holder and pulling a 15 in. Hg vacuum. A leakage rate not in excess of 0.02 c.f.m. at a vacuum of 15 in. Hg is acceptable. Attach the probe and adjust the heater to provide a gas temperature of about 250° F. at the probe outlet. Turn on the filter heating system. Place crushed ice around the impingers. Add more ice during the run to keep the temperature of the gases leaving the last impinger as low as possible and preferably at 70° F. or less. Temperatures above 70° F. may result in damage to the dry gas meter from either moisture condensation or excessive heat.

4.1.3 Particulate train operation. For each run, record the data required on the example sheet shown in Figure 5-2. Take readings at each sampling point, at least every 5 minutes, and when significant changes in stack conditions necessitate additional adjustments in flow rate. To begin sampling, position the nozzle at the first traverse point with the tip pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions. Sample for at least 5 minutes at each traverse point; sampling time must be the same for each point. Maintain isokinetic sampling throughout the sampling period. Nomographs are available which aid in the rapid adjustment of the sampling rate without other computations. APTD-0576 details the procedure for using these nomographs. Turn off the pump at the conclusion of each run and record the final readings. Remove the probe and nozzle from the stack and handle in accordance with the sample recovery process described in section 4.2.

---

[1] Trade name.

[1] Trade name.

[2] Dry using Drierite[1] at 70° F.±10° F.

PLANT____________________

DATE____________________

RUN NO.____________________

CONTAINER NUMBER	WEIGHT OF PARTICULATE COLLECTED, mg		
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
1			
2			
TOTAL			

	VOLUME OF LIQUID WATER COLLECTED	
	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL		
INITIAL		
LIQUID COLLECTED		
TOTAL VOLUME COLLECTED		g* ml

CONVERT WEIGHT OF WATER TO VOLUME BY DIVIDING TOTAL WEIGHT INCREASE BY DENSITY OF WATER. (1 g/ml):

$$\frac{\text{INCREASE, g}}{(1\ \text{g/ml})} = \text{VOLUME WATER, ml}$$

Figure 5-3. Analytical data.

6.6.2 Concentration in lb./cu. ft.

$$c_s = \frac{\left(\frac{1}{453{,}600}\ \frac{\text{lb.}}{\text{mg.}}\right) M_n}{V_{m_{std}}} = 2.205\times10^{-6}\ \frac{M_n}{V_{m_{std}}} \qquad \text{equation 5-5}$$

where:

c_s = Concentration of particulate matter in stack gas, lb./s.c.f., dry basis.

453,600 = Mg/lb.

M_n = Total amount of particulate matter collected, mg.

$V_{m_{std}}$ = Volume of gas sample through dry gas meter (standard conditions), cu. ft.

6.7 Isokinetic variation.

$$I = \frac{T_s\left[\frac{V_{l_c}(\rho_{H_2O})R}{M_{H_2O}} + \frac{V_m}{T_m}\left(P_{bar} + \frac{\Delta H}{13.6}\right)\right]}{\theta V_s P_s A_n} \times 100$$

$$= \frac{\left(1.667\ \frac{\text{min.}}{\text{sec.}}\right)\left[\left(0.00267\ \frac{\text{in. Hg-cu. ft.}}{\text{ml.-°R}}\right)V_{l_c} + \frac{V_m}{T_m}\left(P_{bar} + \frac{\Delta H}{13.6}\right)\right]}{\theta V_s P_s A_n}$$

Equation 5-6

where:

I = Percent of isokinetic sampling.

V_{l_c} = Total volume of liquid collected in impingers and silica gel (See Fig. 5-3), ml.

ρ_{H_2O} = Density of water, 1 g./ml.

R = Ideal gas constant, 21.83 inches Hg-cu. ft./lb.-mole-°R.

M_{H_2O} = Molecular weight of water, 18 lb./lb.-mole.

V_m = Volume of gas sample through the dry gas meter (meter conditions), cu. ft.

T_m = Absolute average dry gas meter temperature (see Figure 5-2), °R.

P_{bar} = Barometric pressure at sampling site, inches Hg.

ΔH = Average pressure drop across the orifice (see Fig. 5-2), inches H₂O.

T_s = Absolute average stack gas temperature (see Fig. 5-2), °R.

θ = Total sampling time, min.

V_s = Stack gas velocity calculated by Method 2, Equation 2-2, ft./sec.

P_s = Absolute stack gas pressure, inches Hg.

A_n = Cross-sectional area of nozzle, sq. ft.

6.8 Acceptable results. The following range sets the limit on acceptable isokinetic sampling results:

If $90\% \leq I \leq 110\%$, the results are acceptable; otherwise, reject the results and repeat the test.

7. *Reference.*

Addendum to Specifications for Incinerator Testing at Federal Facilities, PHS, NCAPC, Dec. 6, 1967.

Martin, Robert M., Construction Details of Isokinetic Source Sampling Equipment, Environmental Protection Agency, APTD-0581.

Rom, Jerome J., Maintenance, Calibration, and Operation of Isokinetic Source Sampling Equipment, Environmental Protection Agency, APTD-0576.

Smith, W. S., R. T. Shigehara, and W. F. Todd, A Method of Interpreting Stack Sampling Data, Paper presented at the 63d Annual Meeting of the Air Pollution Control Association, St. Louis, Mo., June 14-19, 1970.

Smith, W. S., et al., Stack Gas Sampling Improved and Simplified with New Equipment, APCA paper No. 67-119, 1967.

Specifications for Incinerator Testing at Federal Facilities, PHS, NCAPC, 1967.

METHOD 6—DETERMINATION OF SULFUR DIOXIDE EMISSIONS FROM STATIONARY SOURCES

1. *Principle and applicability.*

1.1 Principle. A gas sample is extracted from the sampling point in the stack. The acid mist, including sulfur trioxide, is separated from the sulfur dioxide. The sulfur dioxide fraction is measured by the barium-thorin titration method.

1.2 Applicability. This method is applicable for the determination of sulfur dioxide emissions from stationary sources only when specified by the test procedures for determining compliance with New Source Performance Standards.

2. *Apparatus.*

2.1 Sampling. See Figure 6-1.

2.1.1 Probe—Pyrex[1] glass, approximately 5 to 6 mm. ID, with a heating system to prevent condensation and a filtering medium to remove particulate matter including sulfuric acid mist.

2.1.2 Midget bubbler—One, with glass wool packed in top to prevent sulfuric acid mist carryover.

2.1.3 Glass wool.

2.1.4 Midget impingers—Three.

2.1.5 Drying tube—Packed with 6 to 16 mesh indicating-type silica gel, or equivalent, to dry the sample.

2.1.6 Valve—Needle valve, or equivalent, to adjust flow rate.

2.1.7 Pump—Leak-free, vacuum type.

2.1.8 Rate meter—Rotameter or equivalent, to measure a 0-10 s.c.f.h. flow range.

2.1.9 Dry gas meter—Sufficiently accurate to measure the sample volume within 1%.

2.1.10 Pitot tube—Type S, or equivalent, necessary only if a sample traverse is required, or if stack gas velocity varies with time.

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[1] Trade names.

2.2 Sample recovery.

2.2.1 Glass wash bottles—Two.

2.2.2 Polyethylene storage bottles—To store impinger samples.

2.3 Analysis.

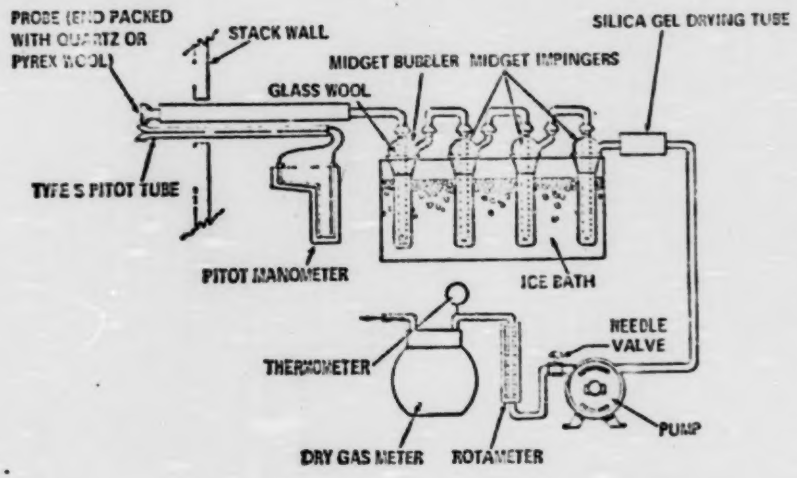

Figure 6-1. SO_2 sampling train.

2.3.1 Pipettes—Transfer type, 5 ml. and 10 ml. sizes (0.1 ml. divisions) and 25 ml. size (0.2 ml. divisions).

2.3.2 Volumetric flasks—50 ml., 100 ml., and 1,000 ml.

2.3.3 Burettes—5 ml. and 50 ml.

2.3.4 Erlenmeyer flask—125 ml.

3. *Reagents.*

3.1 Sampling.

3.1.1 Water—Deionized, distilled.

3.1.2 Isopropanol, 80%—Mix 80 ml. of isopropanol with 20 ml. of distilled water.

3.1.3 Hydrogen peroxide, 3%—dilute 100 ml. of 30% hydrogen peroxide to 1 liter with distilled water. Prepare fresh daily.

3.2 Sample recovery.

3.2.1 Water—Deionized, distilled.

3.2.2 Isopropanol, 80%.

3.3 Analysis.

3.3.1 Water—Deionized, distilled.

3.3.2 Isopropanol.

3.3.3 Thorin indicator—1-(o-arsonophenylazo)-2-naphthol-3,6-disulfonic acid, disodium salt (or equivalent). Dissolve 0.20 g. in 100 ml. distilled water.

3.3.4 Barium perchlorate (0.01 *N*)—Dissolve 1.95 g. of barium perchlorate $[Ba(ClO_4)_2 \cdot 3H_2O]$ in 200 ml. distilled water and dilute to 1 liter with isopropanol. Standardize with sulfuric acid. Barium chloride may be used.

3.3.5 Sulfuric acid standard (0.01 *N*)—Purchase or standardize to ±0.0002 *N* against 0.01N NaOH which has previously been standardized against potassium acid phthalate (primary standard grade).

4. *Procedure.*

4.1 Sampling.

4.1.1 Preparation of collection train. Pour 15 ml. of 80% isopropanol into the midget bubbler and 15 ml. of 3% hydrogen peroxide into each of the first two midget impingers. Leave the final midget impinger dry. Assemble the train as shown in Figure 6-1. Leak check the sampling train at the sampling site by plugging the probe inlet and pulling a 10 inches Hg vacuum. A leakage rate not in excess of 1% of the sampling rate is acceptable. Carefully release the probe inlet plug and turn off the pump. Place crushed ice around the impingers. Add more ice during the run to keep the temperature of the gases leaving the last impinger at 70° F. or less.

4.1.2 Sample collection. Adjust the sample flow rate proportional to the stack gas velocity. Take readings at least every five minutes and when significant changes in stack conditions necessitate additional adjustments in flow rate. To begin sampling, position the tip of the probe at the first sampling point and start the pump. Sample proportionally throughout the run. At the conclusion of each run, turn off the pump and record the final readings. Remove the probe from the stack and disconnect it from the train. Drain the ice bath and purge the remaining part of the train by drawing clean ambient air through the system for 15 minutes.

4.2 Sample recovery. Disconnect the impingers after purging. Discard the contents of the midget bubbler. Pour the contents of the midget impingers into a polyethylene shipment bottle. Rinse the three midget impingers and the connecting tubes with distilled water and add these washings to the same storage container.

4.3 Sample analysis. Transfer the contents of the storage container to a 50 ml. volumetric flask. Dilute to the mark with deionized, distilled water. Pipette a 10 ml. aliquot of this solution into a 125 ml. Erlenmeyer flask. Add 40 ml. of isopropanol and two to four drops of thorin indicator. Titrate to a pink endpoint using 0.01 *N* barium perchlorate. Run a blank with each series of samples.

5. *Calibration.*

5.1 Use standard methods and equipment which have been approved by the Administrator to calibrate the rotameter, pitot tube, dry gas meter, and probe heater.

5.2 Standardize the barium perchlorate against 25 ml. of standard sulfuric acid containing 100 ml. of isopropanol.

6. *Calculations.*

6.1 Dry gas volume. Correct the sample volume measured by the dry gas meter to standard conditions (70° F. and 29.92 inches Hg) by using equation 6-1.

$$V_{m_{std}}=V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar}}{P_{std}}\right)=17.71\,\frac{°R}{in.\ Hg}\left(\frac{V_m P_{bar}}{T_m}\right)\qquad \text{equation 6-1}$$

where:

$V_{m_{std}}$=Volume of gas sample through the dry gas meter (standard conditions), cu. ft.

V_m=Volume of gas sample through the dry gas meter (meter conditions), cu. ft.

T_{std}=Absolute temperature at standard conditions, 530° R.

T_m=Average dry gas meter temperature, °R.

P_{bar}=Barometric pressure at the orifice meter, inches Hg.

P_{std}=Absolute pressure at standard conditions, 29.92 inches Hg.

6.2 Sulfur dioxide concentration.

$$C_{SO_2}=\left(7.05\times10^{-5}\,\frac{lb.\text{-}l.}{g.\text{-}ml.}\right)\frac{(V_t-V_{tb})\,N\left(\frac{V_{soln}}{V_a}\right)}{V_{m_{std}}}\qquad \text{equation 6-2}$$

where:

C_{SO_2}=Concentration of sulfur dioxide at standard conditions, dry basis, lb./cu. ft.

7.05×10^{-5}=Conversion factor, including the number of grams per gram equivalent of sulfur dioxide (32 g./g.-eq.), 453.6 g./lb., and 1,000 ml./l., lb.-l./g.-ml.

V_t=Volume of barium perchlorate titrant used for the sample, ml.

V_{tb}=Volume of barium perchlorate titrant used for the blank, ml.

N=Normality of barium perchlorate titrant, g.-eq./l.

V_{soln}=Total solution volume of sulfur dioxide, 50 ml.

V_a=Volume of sample aliquot titrated, ml.

$V_{m_{std}}$=Volume of gas sample through the dry gas meter (standard conditions), cu. ft., see Equation 6-1.

7. *References.*

Atmospheric Emissions from Sulfuric Acid Manufacturing Processes, U.S. DHEW, PHS, Division of Air Pollution, Public Health Service Publication No. 999-AP-13, Cincinnati, Ohio, 1965.

Corbett, P. F., The Determination of SO_2 and SO_3 in Flue Gases, Journal of the Institute of Fuel, 24:237-243, 1961.

Matty, R. E. and E. K. Diehl, Measuring Flue-Gas SO_2 and SO_3, Power *101*:94-97, November, 1957.

Patton, W. F. and J. A. Brink, Jr., New Equipment and Techniques for Sampling Chemical Process Gases, J. Air Pollution Control Association, *13*, 162 (1963).

METHOD 7—DETERMINATION OF NITROGEN OXIDE EMISSIONS FROM STATIONARY SOURCES

1. *Principle and applicability.*

1.1 Principle. A grab sample is collected in an evacuated flask containing a dilute sulfuric acid-hydrogen peroxide absorbing solution, and the nitrogen oxides, except nitrous oxide, are measure colorimetrically using the phenoldisulfonic acid (PDS) procedure.

1.2 Applicability. This method is applicable for the measurement of nitrogen oxides from stationary sources only when specified by the test procedures for determining compliance with New Source Performance Standards.

2. *Apparatus.*

2.1 Sampling. See Figure 7-1.

2.1.1 Probe—Pyrex[1] glass, heated, with filter to remove particulate matter. Heating is unnecessary if the probe remains dry during the purging period.

2.1.2 Collection flask—Two-liter, Pyrex,[1] round bottom with short neck and 24/40 standard taper opening, protected against implosion or breakage.

2.1.3 Flask valve—T-bore stopcock connected to a 24/40 standard taper joint.

2.1.4 Temperature gauge—Dial-type thermometer, or equivalent, capable of measuring 2° F. intervals from 25° to 125° F.

2.1.5 Vacuum line—Tubing capable of withstanding a vacuum of 3 inches Hg absolute pressure, with "T" connection and T-bore stopcock, or equivalent.

2.1.6 Pressure gauge—U-tube manometer, 36 inches, with 0.1-inch divisions, or equivalent.

2.1.7 Pump—Capable of producing a vacuum of 3 inches Hg absolute pressure.

2.1.3 Squeeze bulb—One way.

2.2 Sample recovery.

2.2.1 Pipette or dropper.

2.2.2 Glass storage containers—Cushioned for shipping.

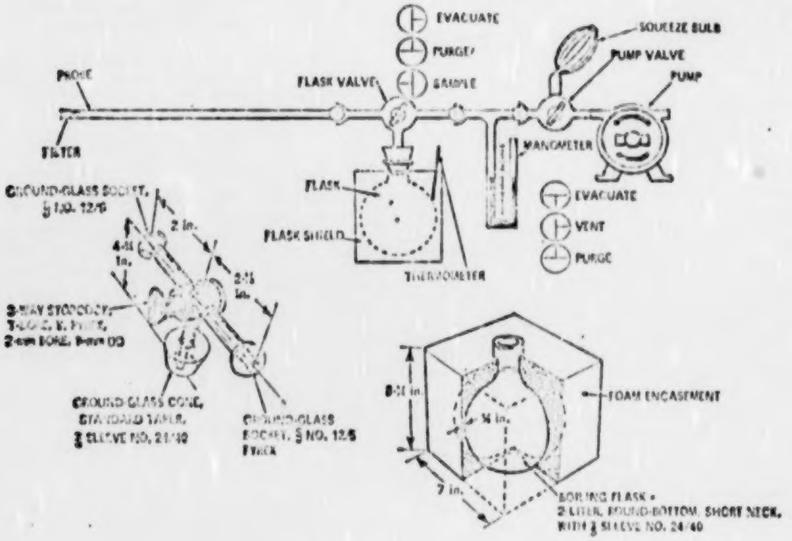
EVACUATE
PURGE
SAMPLE
SQUEEZE BULB
PUMP VALVE
PUMP
PROBE
FLASK VALVE
FILTER
MANOMETER
FLASK
FLASK SHIELD
THERMOMETER
EVACUATE
VENT
PURGE
GROUND-GLASS SOCKET, § NO. 12/5
2 in.
4-8 in.
2½ in.
3-WAY STOPCOCK, T-BORE, § PYREX, 2-mm BORE, 8-mm OD
GROUND-GLASS CONE, STANDARD TAPER, § SLEEVE NO. 24/40
GROUND-GLASS SOCKET, § NO. 12/5 PYREX
FOAM ENCASEMENT
8½ in.
¾ in.
7 in.
BOILING FLASK - 2-LITER, ROUND-BOTTOM, SHORT NECK, WITH § SLEEVE NO. 24/40

Figure 7-1. Sampling train, flask valve, and flask.

2.2.3 Glass wash bottle.

2.3 Analysis.

2.3.1 Steam bath.

2.3.2 Beakers or casseroles—250 ml., one for each sample and standard (blank).

2.3.3 Volumetric pipettes—1, 2, and 10 ml.

2.3.4 Transfer pipette—10 ml. with 0.1 ml. divisions.

2.3.5 Volumetric flask—100 ml., one for each sample, and 1,000 ml. for the standard (blank).

2.3.6 Spectrophotometer—To measure absorbance at 420 nm.

2.3.7 Graduated cylinder—100 ml. with 1.0 ml. divisions.

2.3.8 Analytical balance—To measure to 0.1 mg.

3. *Reagents.*

3.1 Sampling.

3.1.1 Absorbing solution—Add 2.8 ml. of concentrated H_2SO_4 to 1 liter of distilled water. Mix well and add 6 ml. of 3 percent hydrogen peroxide. Prepare a fresh solution weekly and do not expose to extreme heat or direct sunlight.

3.2 Sample recovery.

3.2.1 Sodium hydroxide (1*N*)—Dissolve 40 g. NaOH in distilled water and dilute to 1 liter.

3.2.2 Red litmus paper.

3.2.3 Water—Deionized, distilled.

3.3 Analysis.

3.3.1 Fuming sulfuric acid—15 to 18% by weight free sulfur trioxide.

3.3.2 Phenol—White solid reagent grade.

3.3.3 Sulfuric acid—Concentrated reagent grade.

3.3.4 Standard solution—Dissolve 0.5495 g. potassium nitrate (KNO_3) in distilled water and dilute to 1 liter. For the working standard solution, dilute 10 ml. of the resulting solution to 100 ml. with distilled water. One ml. of the working standard solution is equivalent to 25 μg. nitrogen dioxide.

3.3.5 Water—Deionized, distilled.

3.3.6 Phenoldisulfonic acid solution—Dissolve 25 g. of pure white phenol in 150 ml. concentrated sulfuric acid on a steam bath. Cool, add 75 ml. fuming sulfuric acid, and heat at 100° C. for 2 hours. Store in a dark, stoppered bottle.

4. *Procedure.*

4.1 Sampling.

4.1.1 Pipette 25 ml. of absorbing solution into a sample flask. Insert the flask valve stopper into the flask with the valve in the "purge" position. Assemble the sampling train as shown in Figure 7-1 and place the probe at the sampling point. Turn the flask valve and the pump valve to their "evacuate" positions. Evacuate the flask to at least 3 inches Hg absolute pressure. Turn the pump valve to its "vent" position and turn off the pump. Check the manometer for any fluctuation in the mercury level. If there is a visible change over the span of one minute, check for leaks. Record the initial volume, temperature, and barometric pressure. Turn the flask valve to its "purge" position, and then do the same with the pump valve. Purge the probe and the vacuum tube using the squeeze bulb. If condensation occurs in the probe and flask valve area, heat the probe and purge until the condensation disappears. Then turn the pump valve to its "vent" position. Turn the flask valve to its "sample" position and allow sample to enter the flask for about 15 seconds. After collecting the sample, turn the flask valve to its "purge" position and disconnect the flask from the sampling train. Shake the flask for 5 minutes.

4.2 Sample recovery.

4.2.1 Let the flask set for a minimum of 16 hours and then shake the contents for 2 minutes. Connect the flask to a mercury filled U-tube manometer, open the valve from the flask to the manometer, and record the flask pressure and temperature along with the barometric pressure. Transfer the flask contents to a container for shipment or to a 250 ml. beaker for analysis. Rinse the flask with two portions of distilled water (approximately 10 ml.) and add rinse water to the sample. For a blank use 25 ml. of absorbing solution and the same volume of distilled water as used in rinsing the flask. Prior to shipping or analysis, add sodium hydroxide (1*N*) dropwise into both the sample and the blank until alkaline to litmus paper (about 25 to 35 drops in each).

4.3 Analysis.

4.3.1 If the sample has been shipped in a container, transfer the contents to a 250 ml. beaker using a small amount of distilled water. Evaporate the solution to dryness on a steam bath and then cool. Add 2 ml. phenoldisulfonic acid solution to the dried residue and triturate thoroughly with a glass rod. Make sure the solution contacts all the residue. Add 1 ml. distilled water and four drops of concentrated sulfuric acid. Heat the solution on a steam bath for 3 minutes with occasional stirring. Cool, add 20 ml. distilled water, mix well by stirring, and add concentrated ammonium hydroxide dropwise with constant stirring until alkaline to litmus paper. Transfer the solution to a 100 ml. volumetric flask and wash the beaker three times with 4 to 5 ml. portions of distilled water. Dilute to the mark and mix thoroughly. If the sample contains solids, transfer a portion of the solution to a clean, dry centrifuge tube, and centrifuge, or filter a portion of the solution. Measure the absorbance of each sample at 420 nm. using the blank solution as a zero. Dilute the sample and the blank with a suitable amount of distilled water if absorbance falls outside the range of calibration.

5. *Calibration.*

5.1 Flask volume. Assemble the flask and flask valve and fill with water to the stopcock. Measure the volume of water to ±10 ml. Number and record the volume on the flask.

5.2 Spectrophotometer. Add 0.0 to 16.0 ml. of standard solution to a series of beakers. To each beaker add 25 ml. of absorbing solution and add sodium hydroxide (1*N*) dropwise until alkaline to litmus paper (about 25 to 35 drops). Follow the analysis procedure of section 4.3 to collect enough data to draw a calibration curve of concentration in μg. NO_2 per sample versus absorbance.

6. *Calculations.*

6.1 Sample volume.

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[1] Trade name.

$$V_{sc}=\frac{T_{std}(V_f-V_a)}{P_{std}}\left(\frac{P_f}{T_f}-\frac{P_i}{T_i}\right)=\left(17.71\frac{°R}{in.\ Hg}\right)(V_f-25\ ml.)\left(\frac{P_f}{T_f}-\frac{P_i}{T_i}\right)\quad \text{Equation 7-1}$$

where:

V_{sc} = Sample volume at standard conditions (dry basis), ml.

T_{std} = Absolute temperature at standard conditions, 530° R.

P_{std} = Pressure at standard conditions, 29.92 inches Hg.

V_f = Volume of flask and valve, ml.

V_a = Volume of absorbing solution, 25 ml.

P_f = Final absolute pressure of flask, inches Hg.

P_i = Initial absolute pressure of flask, inches Hg.

T_f = Final absolute temperature of flask, °R.

T_i = Initial absolute temperature of flask, °R.

6.2 Sample concentration. Read μg. NO_2 for each sample from the plot of μg. NO_2 versus absorbance.

$$C=\left(\frac{m}{V_{sc}}\right)\left(\frac{\frac{1\ lb.}{cu.\ ft.}}{1.6\times10^{4}\frac{\mu g.}{ml.}}\right)=\left(6.2\times10^{-5}\frac{lb./s.c.f.}{\mu g./ml.}\right)\left(\frac{m}{V_{sc}}\right)\quad \text{equation 7-2}$$

where:

C = Concentration of NO_x as NO_2 (dry basis), lb./s.c.f.

m = Mass of NO_2 in gas sample, μg.

V_{sc} = Sample volume at standard conditions (dry basis), ml.

7. *References.*

Standard Methods of Chemical Analysis. 6th ed. New York, D. Van Nostrand Co., Inc., 1962, vol. 1, p. 329-330.

Standard Method of Test for Oxides of Nitrogen in Gaseous Combustion Products (Phenoldisulfonic Acid Procedure), In: 1968 Book of ASTM Standards, Part 23, Philadelphia, Pa. 1968, ASTM Designation D-1608-60, p. 725-729.

Jacob, M. B., The Chemical Analysis of Air Pollutants, New York, N.Y., Interscience Publishers, Inc., 1960, vol. 10, p. 351-356.

METHOD 8—DETERMINATION OF SULFURIC ACID MIST AND SULFUR DIOXIDE EMISSIONS FROM STATIONARY SOURCES

1. *Principle and applicability.*

1.1 Principle. A gas sample is extracted from a sampling point in the stack and the acid mist including sulfur trioxide is separated from sulfur dioxide. Both fractions are measured separately by the barium-thorin titration method.

1.2 Applicability. This method is applicable to determination of sulfuric acid mist (including sulfur trioxide) and sulfur dioxide from stationary sources only when specified by the test procedures for determining compliance with the New Source Performance Standards.

2. *Apparatus.*

2.1 Sampling. See Figure 8-1. Many of the design specifications of this sampling train are described in APTD-0581.

2.1.1 Nozzle—Stainless steel (316) with sharp, tapered leading edge.

2.1.2 Probe—Pyrex[1] glass with a heating system to prevent visible condensation during sampling.

2.1.3 Pitot tube—Type S, or equivalent, attached to probe to monitor stack gas velocity.

2.1.4 Filter holder—Pyrex[1] glass.

2.1.5 Impingers—Four as shown in Figure 8-1. The first and third are of the Greenburg-Smith design with standard tip. The second and fourth are of the Greenburg-Smith design, modified by replacing the standard tip with a ½-inch ID glass tube extending to one-half inch from the bottom of the impinger flask. Similar collection systems, which have been approved by the Administrator, may be used.

2.1.6 Metering system—Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 5° F., dry gas meter with 2% accuracy, and related equipment, or equivalent, as required to maintain an isokinetic sampling rate and to determine sample volume.

2.1.7 Barometer—To measure atmospheric pressure to ±0.1 inch Hg.

2.2 Sample recovery.

2.2.1 Wash bottles—Two.

2.2.2 Graduated cylinders—250 ml., 500 ml.

2.2.3 Glass sample storage containers.

2.2.4 Graduated cylinder—250 ml.

2.3 Analysis.

2.3.1 Pipette—25 ml., 100 ml.

2.3.2 Burette—50 ml.

2.3.3 Erlenmeyer flask—250 ml.

2.3.4 Graduated cylinder—100 ml.

2.3.5 Trip balance—300 g. capacity, to measure to ±0.05 g.

2.3.6 Dropping bottle—to add indicator solution.

3. *Reagents.*

3.1 Sampling.

3.1.1 Filters—Glass fiber, MSA type 1106 BH, or equivalent, of a suitable size to fit in the filter holder.

3.1.2 Silica gel—Indicating type, 6-16 mesh, dried at 175° C. (350° F.) for 2 hours.

3.1.3 Water—Deionized, distilled.

3.1.4 Isopropanol, 80%—Mix 800 ml. of isopropanol with 200 ml. of deionized, distilled water.

3.1.5 Hydrogen peroxide, 3%—Dilute 100 ml. of 30% hydrogen peroxide to 1 liter with deionized, distilled water.

3.1.6 Crushed ice.

3.2 Sample recovery.

3.2.1 Water—Deionized, distilled.

3.2.2 Isopropanol, 80%.

3.3 Analysis.

3.3.1 Water—Deionized, distilled.

3.3.2 Isopropanol.

3.3.3 Thorin indicator—1-(o-arsonophenylazo)-2-naphthol-3, 6-disulfonic acid, disodium salt (or equivalent). Dissolve 0.20 g. in 100 ml. distilled water.

3.3.4 Barium perchlorate (0.01*N*)—Dissolve 1.95 g. of barium perchlorate [$Ba(ClO_4)_2 \cdot 3H_2O$] in 200 ml. distilled water and dilute to 1 liter with isopropanol. Standardize with sulfuric acid.

3.3.5 Sulfuric acid standard (0.01*N*)—Purchase or standardize to ± 0.0002 *N* against 0.01 *N* NaOH which has previously been standardized against primary standard potassium acid phthalate.

4. *Procedure.*

4.1 Sampling.

4.1.1 After selecting the sampling site and the minimum number of sampling points, determine the stack pressure, temperature, moisture, and range of velocity head.

4.1.2 Preparation of collection train. Place 100 ml. of 80% isopropanol in the first impinger, 100 ml. of 3% hydrogen peroxide in both the second and third impingers, and about 200 g. of silica gel in the fourth impinger. Retain a portion of the reagents for use as blank solutions. Assemble the train without the probe as shown in Figure 8-1 with the filter between the first and second impingers. Leak check the sampling train at the sampling site by plugging the inlet to the first impinger and pulling a 15-inch Hg vacuum. A leakage rate not in excess of 0.02 c.f.m. at a vacuum of 15 inches Hg is acceptable. Attach the probe and turn on the probe heating system. Adjust the probe heater setting during sampling to prevent any visible condensation. Place crushed ice around the impingers. Add more ice during the run to keep the temperature of the gases leaving the last impinger at 70° F. or less.

4.1.3 Train operation. For each run, record the data required on the example sheet shown in Figure 8-2. Take readings at each sampling point at least every 5 minutes and when significant changes in stack conditions necessitate additional adjustments in flow rate. To begin sampling, position the nozzle at the first traverse point with the tip pointing directly into the gas stream. Start the pump and immediately adjust the flow to isokinetic conditions. Maintain isokinetic sampling throughout the sampling period. Nomographs are available which aid in the

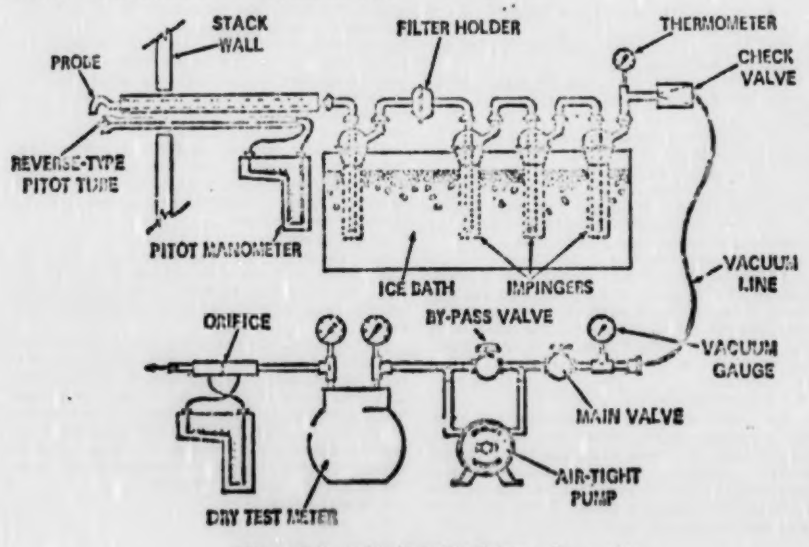

Figure 8-1. Sulfuric acid mist sampling train.

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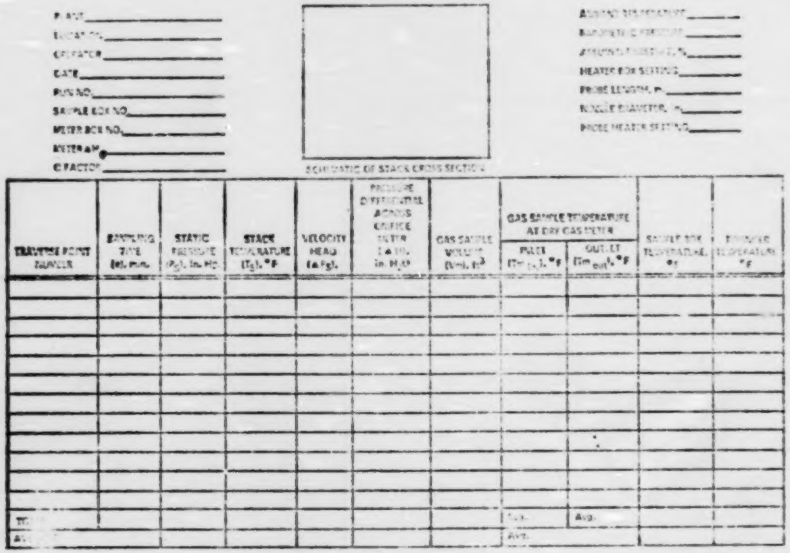
[1] Trade name.

rapid adjustment of the sampling rate without other computations. APTD-0576 details the procedure for using these nomographs. At the conclusion of each run, turn off the pump and record the final readings. Remove the probe from the stack and disconnect it from the train. Drain the ice bath and purge the remaining part of the train by drawing clean ambient air through the system for 15 minutes.



PLANT	
LOCATION	
OPERATOR	
DATE	
RUN NO.	
SAMPLE BOX NO.	
METER BOX NO.	
METER ΔH@	
C FACTOR	

SCHEMATIC OF STACK CROSS SECTION

AMBIENT TEMPERATURE	
BAROMETRIC PRESSURE	
ASSUMED MOISTURE, %	
HEATER BOX SETTING	
PROBE LENGTH, m	
NOZZLE DIAMETER, in.	
PROBE HEATER SETTING	

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (Ps), in. Hg.	STACK TEMPERATURE (Ts), °F	VELOCITY HEAD (ΔPs)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH), in. H₂O	GAS SAMPLE VOLUME (Vm), ft³	GAS SAMPLE TEMPERATURE AT DRY GAS METER		SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
							INLET (Tm in), °F	OUTLET (Tm out), °F		
TOTAL							Avg.	Avg.		
AVERAGE							Avg.			

Figure 8-2. Field data.

4.2 Sample recovery.

4.2.1 Transfer the isopropanol from the first impinger to a 250 ml. graduated cylinder. Rinse the probe, first impinger, and all connecting glassware before the filter with 80% isopropanol. Add the rinse solution to the cylinder. Dilute to 250 ml. with 80% isopropanol. Add the filter to the solution, mix, and transfer to a suitable storage container. Transfer the solution from the second and third impingers to a 500 ml. graduated cylinder. Rinse all glassware between the filter and silica gel impinger with deionized, distilled water and add this rinse water to the cylinder. Dilute to a volume of 500 ml. with deionized, distilled water. Transfer the solution to a suitable storage container.

4.3 Analysis.

4.3.1 Shake the container holding isopropanol and the filter. If the filter breaks up, allow the fragments to settle for a few minutes before removing a sample. Pipette a 100 ml. aliquot of sample into a 250 ml. Erlenmeyer flask and add 2 to 4 drops of thorin indicator. Titrate the sample with barium perchlorate to a pink end point. Make sure to record volumes. Repeat the titration with a second aliquot of sample. Shake the container holding the contents of the second and third impingers. Pipette a 25 ml. aliquot of sample into a 250 ml. Erlenmeyer flask. Add 100 ml. of isopropanol and 2 to 4 drops of thorin indicator. Titrate the sample with barium perchlorate to a pink end point. Repeat the titration with a second aliquot of sample. Titrate the blanks in the same manner as the samples.

5. *Calibration.*

5.1 Use standard methods and equipment which have been approved by the Administrator to calibrate the orifice meter, pitot tube, dry gas meter, and probe heater.

5.2 Standardize the barium perchlorate with 25 ml. of standard sulfuric acid containing 100 ml. of isopropanol.

6. *Calculations.*

6.1 Dry gas volume. Correct the sample volume measured by the dry gas meter to standard conditions (70° F., 29.92 inches Hg) by using Equation 8-1.

$$V_{m_{std}}=V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar}+\frac{\Delta H}{13.6}}{P_{std}}\right)=\left(17.71\frac{°R}{in.\ Hg}\right)V_m\left(\frac{P_{bar}+\frac{\Delta H}{13.6}}{T_m}\right)$$

equation 8-1

where:

$V_{m_{std}}$ = Volume of gas sample through the dry gas meter (standard conditions), cu. ft.

V_m = Volume of gas sample through the dry gas meter (meter conditions), cu. ft.

T_{std} = Absolute temperature at standard conditions, 530° R.

T_m = Average dry gas meter temperature, °R.

P_{bar} = Barometric pressure at the orifice meter, inches Hg.

ΔH = Pressure drop across the orifice meter, inches H_2O.

13.6 = Specific gravity of mercury.

P_{std} = Absolute pressure at standard conditions, 29.92 inches Hg.

6.2 Sulfuric acid concentration.

$$C_{H_2SO_4}=\left(1.08\times10^{-4}\frac{lb.\text{-}l.}{g.\text{-}ml.}\right)\frac{(V_t-V_{tb})(\underline{N})\left(\frac{V_{soln}}{V_a}\right)}{V_{m_{std}}}$$

equation 8-2

$C_{H_2SO_4}$ = Concentration of sulfuric acid at standard conditions, dry basis, lb./cu. ft.

1.08×10^{-4} = Conversion factor including the number of grams per gram equivalent of sulfuric acid (49 g./g.-eq.), 453.6 g./lb., and 1,000 ml./l., lb.-l./g.-ml.

V_t = Volume of barium perchlorate titrant used for the sample, ml.

V_{tb} = Volume of barium perchlorate titrant used for the blank, ml.

N = Normality of barium perchlorate titrant, g.-eq./l.

V_{soln} = Total solution volume of sulfuric acid (first impinger and filter), ml.

V_a = Volume of sample aliquot titrated, ml.

$V_{m_{std}}$ = Volume of gas sample through the dry gas meter (standard conditions), cu. ft., see Equation 8-1.

6.3 Sulfur dioxide concentration.

$$C_{SO_2}=\left(7.05\times10^{-5}\frac{lb.\text{-}l.}{g.\text{-}ml.}\right)\frac{(V_t-V_{tb})(\underline{N})\left(\frac{V_{soln}}{V_a}\right)}{V_{m_{std}}}$$

equation 8-3

where:

C_{SO_2} = Concentration of sulfur dioxide at standard conditions, dry basis, lb./cu. ft.

7.05×10^{-5} = Conversion factor including the number of grams per gram equivalent of sulfur dioxide (32 g./g.-eq.), 453.6 g./lb., and 1,000 ml./l., lb.-l./g.-ml.

V_t = Volume of barium perchlorate titrant used for the sample, ml.

V_{tb} = Volume of barium perchlorate titrant used for the blank, ml.

N = Normality of barium perchlorate titrant, g.-eq./l.

V_{soln} = Total solution volume of sulfur dioxide (second and third impingers), ml.

V_a = Volume of sample aliquot titrated, ml.

$V_{m_{std}}$ = Volume of gas sample through the dry gas meter (standard conditions), cu. ft., see Equation 8-1.

7. *References.*

Atmospheric Emissions from Sulfuric Acid Manufacturing Processes, U.S. DHEW, PHS, Division of Air Pollution, Public Health Service Publication No. 999-AP-13, Cincinnati, Ohio, 1965.

Corbett, D. F., The Determination of SO_2 and SO_3 in Flue Gases, Journal of the Institute of Fuel, 24:237-243, 1961.

Martin, Robert M., Construction Details of Isokinetic Source Sampling Equipment, Environmental Protection Agency, Air Pollution Control Office Publication No. APTD-0581.

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Rom, Jerome J., Maintenance, Calibration, and Operation of Isokinetic Source Sampling Equipment, Environmental Protection Agency, Air Pollution Control Office Publication No. APTD-0576.

Shell Development Co. Analytical Department, Determination of Sulfur Dioxide and Sulfur Trioxide in Stack Gases, Emeryville Method Series, 4516/59a.

METHOD 9—VISUAL DETERMINATION OF THE OPACITY OF EMISSIONS FROM STATIONARY SOURCES

1. *Principle and applicability.*

1.1 Principle. The relative opacity of an emission from a stationary source is determined visually by a qualified observer.

1.2 Applicability. This method is applicable for the determination of the relative opacity of visible emissions from stationary sources only when specified by test procedures for determining compliance with the New Source Performance Standards.

2. *Procedure.*

2.1 The qualified observer stands at approximately two stack heights, but not more than a quarter of a mile from the base of the stack with the sun to his back. From a vantage point perpendicular to the plume, the observer studies the point of greatest opacity in the plume. The data required in Figure 9-1 is recorded every 15 to 30 seconds to the nearest 5% opacity. A minimum of 25 readings is taken.

3. *Qualifications.*

3.1 To certify as an observer, a candidate must complete a smokereading course conducted by EPA, or equivalent; in order to certify the candidate must assign opacity readings in 5% increments to 25 different black plumes and 25 different white plumes, with an error not to exceed 15 percent on any one reading and an average error not to exceed 7.5 percent in each category. The smoke generator used to qualify the observers must be equipped with a calibrated smoke indicator or light transmission meter located in the source stack if the smoke generator is to determine the actual opacity of the emissions. All qualified observers must pass this test every 6 months in order to remain certified.

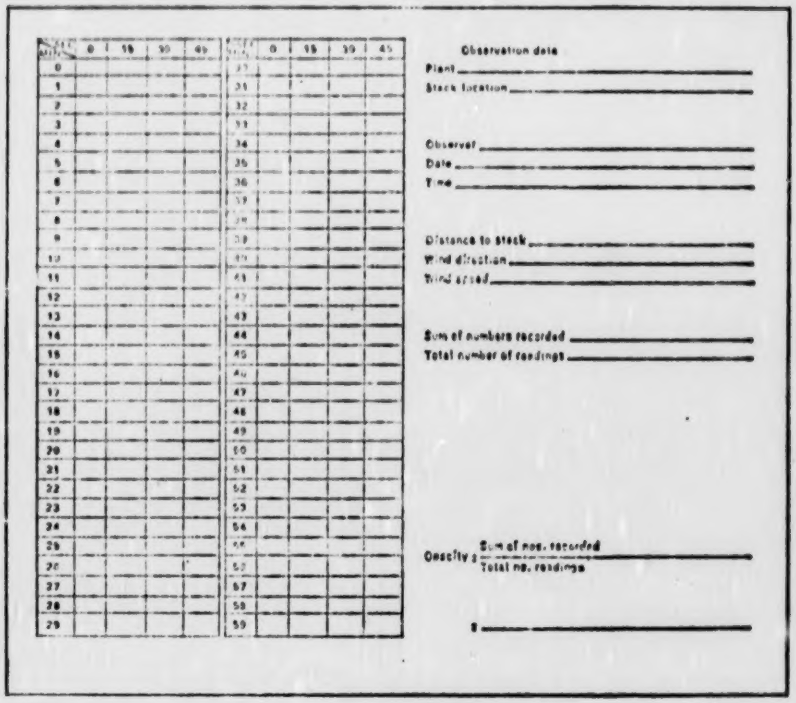
4. *Calculations.*

4.1 Determine the average opacity.

5. *References.*

Air Pollution Control District Rules and Regulations, Los Angeles County Air Pollution Control District, Chapter 2, Schedule 6, Regulation 4, Prohibition, Rule 50, 17 p.

Kudluk, Rudolf, Ringelmann Smoke Chart, U.S. Department of Interior, Bureau of Mines, Information Circular No. 8333, May 1967.



Sec./Min.	0	15	30	45	Sec./Min.	0	15	30	45
0					30				
1					31				
2					32				
3					33				
4					34				
5					35				
6					36				
7					37				
8					38				
9					39				
10					40				
11					41				
12					42				
13					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				

Observation data

Plant ______

Stack location ______

Observer ______

Date ______

Time ______

Distance to stack ______

Wind direction ______

Wind speed ______

Sum of numbers recorded ______

Total number of readings ______

Opacity $= \frac{\text{Sum of nos. recorded}}{\text{Total no. readings}}$ ______

= ______

Figure 9-1. Field data.

[FR Doc.71-18624 Filed 12-22-71;8:45 am]

REGULATION NO. 7

Regulation to Control the Emissions of Hydrocarbon Vapors

Air Pollution Control Commission

Adopted: September 13, 1973
Effective Date: November 28, 1973

REGULATION NO. 7

Regulation to Control the Emissions of Hydrocarbon Vapors

A. AFFECTED AREAS:

1. Sections F and G shall apply Statewide.

2. Sections B, E, H, I, and J, shall apply only to designated air pollution control areas.

3. Sections C and D shall apply only to the designated Denver-Metro air pollution control area.

4. All references to designated air pollution control areas, throughout this regulation, shall be as shown on page 1.13 of the Commission Regulation No. 1.

B. PETROLEUM PRODUCT STORAGE:

1. The storage of any type of petroleum distillate in any stationary tank, reservoir, or other container of more than 40,000 gallons (152,000 liters) shall be in a pressure tank capable of maintaining working pressures sufficient at all times to prevent vapor loss to the atmosphere. Said tank, reservoir, or other container shall be equipped with one or more of the following, properly installed, in good working order, and properly maintained:

   (a) A pontoon-type or double deck-type floating roof, or internal floating cover, which shall rest on the surface of the liquid contents and shall be equipped with a closure seal or seals to close the space between the roof edge and tank wall. This control equipment shall be acceptable for said tanks, reservoirs, or other containers only if any type of petroleum distillate has a vapor pressure not exceeding 11 pounds per square inch absolute (568mm.Hg) under actual storage conditions. All gauging or sampling devices shall be vapor-tight, except when tank gauging or sampling is taking place; or

   (b) A vapor recovery system, consisting of a vapor gathering system capable of collecting the hydrocarbon vapors discharged, together with a vapor disposal system capable of processing such vapors so as to prevent their emission to the atmosphere. All gauging and sampling devices shall be vapor-tight except when gauging or sampling is taking place.

(c) Other equipment of equal control efficiency, provided the design and effectiveness of such equipment as documented is submitted to and approved by the Division.

2. This Section B.1 shall also apply to the storage of crude oil within the designated Denver-Metro air pollution control area.

3. Propane or butane and similar products shall be stored in pressure tanks maintaining working pressures sufficient at all times to prevent hydrocarbon vapor loss to the atmosphere, or at refrigerated low temperature, or in low pressure storage equipped with vapor collection and compression equipment designed to prevent the loss of hydrocarbon vapor to the atmosphere.

4. The storage of any petroleum distillate in any stationary storage vessel of more than 3,500 gallons (13,300 liters) capacity shall be in a vessel equipped with a permanent submerged fill pipe or with a vapor recovery system.

C. PETROLEUM DISTILLATE LOADING INTO TANK TRUCKS, TRAILERS, AND OTHER TRANSPORT VEHICLES:

1. The loading of any type of petroleum distillate into any tank truck, trailer, or other transport vehicle shall be from a loading facility equipped with a vapor collection and disposal system or its equivalent, properly installed, in good working order, and properly maintained. Also, the loading facility shall be equipped with a loading arm with a vapor collection adaptor. Said system must also have pneumatic, hydraulic, or other equivalent mechanical means to force a vapor-tight seal between the adaptor and the hatch. A means shall be provided to prevent drainage of petroleum distillate from the loading device when it is removed from the hatch of any tank truck, trailer, or other transport vehicle, or to accomplish complete draining before the removal. When loading is effected through means other than hatches, all loading and vapor lines shall be equipped with fittings which make vapor-tight connections and which close automatically when disconnected.

2. Vapor recovery may be accomplished by one or more of the following:

   (a) A vapor-liquid absorber system where vapor emissions do not exceed 1.5 pounds (1,000 gallons loaded at 70°F, 1 Atmosphere)

   (b) Bottom loading (closed hatches) at terminal racks where vapor emissions do not exceed 1.5 pounds (1,000 gallons loaded at 70°F, 1 Atmosphere).

   (c) Other equipment where vapor emissions do not exceed 1.5 pounds (1,000 gallons loaded at 70°F, 1 Atmosphere) and as approved by the Division.

3. This section C shall apply only to petroleum distillate loading facilities where 40,000 gallons or more, averaged over the work days of any month, are loaded in any one day. Facilities loading under 40,000 gallons per day, such as bulk plants, shall install telescoping top-loading equipment, or a demonstrated equivalent, to provide 97% submerged fill.

4. For the purpose of this regulation, "loading facility" means any aggregation or combination of petroleum distillate loading equipment which is (1) owned or operated by one person, and (2) located so that all the petroleum distillate loading outlets for such aggregation or combination of loading equipment as encompassed within a circle of 300 feet in diameter.

D. WATER SEPARATION FROM PETROLEUM PRODUCTS:

1. Single or multiple compartment oil and effluent water separation equipment which receives effluent water containing 200 gallons (760 liters) or more a day or more of any petroleum product or mixture of petroleum products from any equipment used for processing, refining, treating, storing, or handling of petroleum products having a Reid vapor pressure of 0.5 pound or greater, shall be equipped with one or more of the following vapor loss control devices, properly installed, in good working order, and properly maintained:

   (a) A solid cover with all openings sealed and the liquid contents totally enclosed. All gauging and sampling devices shall be vapor-tight except when gauging or sampling is taking place.

   (b) A pontoon-type or double deck-type floating roof, or internal floating cover, resting on the surface of the contents and equipped with a closure seal or seals to close the space between the roof edge and container wall. All gauging and sampling devices shall be vapor-tight except when gauging or sampling is taking place.

   (c) A vapor recovery system consisting of a vapor gathering system capable of collecting the hydrocarbon vapors discharged and a vapor disposal system capable of processing such hydrocarbon vapors so as to prevent their emission to the atmosphere. All container gauging and sampling devices shall be vapor-tight, except when gauging or sampling is taking place.

   (d) Other equipment of equal or greater efficiency, provided the design and effectiveness of such equipment as documented is submitted to and approved by the Division.

2. This section D shall also apply to oil and effluent water separators used in conjunction with the production of crude oil.

E. PUMPS AND COMPRESSORS:

1. No person may build, install, or permit the building or installation of any rotating pump or compressor handling any type of petroleum distillate unless said pump or compressor is equipped with mechanical seals or other equipment of equal efficiency. If reciprocating-type pumps and compressors are used, they shall be equipped with packing glands properly installed, in good working order, and properly maintained so no emissions occur from the drain recovery systems.

2. This section E shall also apply to pumps and compressors handling crude oil within the designated Denver-Metro air pollution control area.

F. WASTE GAS DISPOSAL:

Any waste gas stream containing hydrocarbon compounds from any polymer process emission source shall be burned at 1,300°F (704°C.) for 0.3 second or longer, in a direct-flame afterburner or an equally effective device. The emissions of hydrocarbon vapors from a vapor blowdown system or emergency relief shall be burned in smokeless flares, or equipment of equal efficiency, provided the design and effectiveness of equipment, as documented, is submitted to and approved by the Division.

G. ORGANIC SOLVENTS:

1. No person may discharge into the atmosphere more than 15 pounds of organic materials in any one day, nor more than 3 pounds thereof in any one hour, from any article, machine, equipment or other contrivances in which any organic solvent or any material containing organic solvent comes in contact with flame or is baked, heat-cured, or heat-polymerized, in the presence of oxygen, unless said discharge has been reduced by at least 85 percent. Those portions of any series of articles, machines, equipment, or other contrivances designed for processing a continuous web, strip, or wire which emit organic materials and use operations described in this subsection 1 shall be collectively subject to compliance with this subsection.

2. No person may discharge into the atmosphere more than 40 pounds of organic materials in any one day, nor more than 8 pounds in any one hour, from any article, machine, equipment, or other contrivance used under conditions other than described in section 1, for employing, or applying, any photochemically reactive solvent, as defined in subsection 10 of this section, or material containing such photochemically reactive solvent, unless said discharge has been reduced by at least 85 percent. Emissions of organic materials into the atmosphere resulting from air or heated drying of products for the first 12 hours after their removal from any article, machine, equipment, or other contrivance described in this section G shall be included in determining compliance with this section. Emissions resulting from baking, heat-curing, or heat-polymerizing as described in subsection 1 of this section shall be excluded from determination of compliance with this section. Those portions of any series of articles, machines, equipment, or other contrivances designed for processing a continuous web, strip, or wire which emit organic materials and use operations described in this subsection 2 shall be collectively subject to compliance with this subsection 2.

3. No person may, after December 31, 1974, discharge into the atmosphere more than 3,000 pounds of organic materials in any one day, nor more than 450 pounds in any one hour, from any article, machine, equipment, or other contrivance in which any non-photochemically reactive organic solvent or any material containing such solvent is employed or applied, unless said discharge has been reduced by at least 85 percent. Emissions of organic materials into the atmosphere resulting from air or heated drying of products for the first 12 hours after their removal from any article, machine, equipment, or other contrivance described in this section G shall be included in determining compliance with this subsection 3. Emissions resulting from baking, heat-curing, or heat-polymerizing as described in subsection 1 of this section shall be excluded from determination of compliance with this subsection. Those portions of any series of articles, machines, equipment, or other contrivances designed for processing a continuous web, strip, or wire which emit organic materials and use operations described in this subsection 3 shall be collectively subject to compliance with this section.

4. Emissions of organic materials to the atmosphere from the clean-up, with photochemically reactive solvent as defined in subsection 10 of this section, of any article, machine, equipment, or other contrivance described in subsections 1, 2, or 3, of this section G shall be included with the other emissions of organic materials from that article, machine, equipment, or other contrivance for determining compliance with this section G.

5. Emissions of organic materials into the atmosphere required to be controlled by subsections 1, 2, and 3 of this section G shall be reduced by:

   (a) Incineration, provided that 90 percent or more of the carbon in the organic material being incinerated is oxidized to carbon dioxide,

   (b) Adsorption, or

   (c) Processing in a manner to be not less efficient than (a) or (b) above, provided said processing and equipment, as documented, is submitted to and approved by the Division.

6. A person processing organic materials pursuant to this section G shall provide, properly installed, in good working order, and properly maintained devices as specified in the authority to construct and the permit to operate, or as otherwise specified by the Division, for indicating temperatures, pressures, rates of flow, or other operating conditions necessary to determine the degree and effectiveness of air pollution control.

7. Any person using organic solvents or any materials containing organic solvents shall supply the Division, upon request and in the manner and form prescribed by it, written evidence of the chemical composition, physical properties, and amount consumed for each organic solvent used.

8. The provisions of this section G shall not apply to:

   (a) The manufacture of organic solvents, or the transport or storage of organic solvents or materials containing organic solvents.

   (b) The use of equipment for which other requirements are specified by subsections 1, 2, and 3, of this section G this regulation, or which are exempt from air pollution control requirements.

   (c) The spraying or other employment of insecticides, pesticides, or herbicides.

   (d) The employment, application, evaporation, or drying of saturated halogenated hydrocarbons, perchloroethylene, or trichloroethylene, provided the emission of organic materials is controlled to less than 40 pounds per day or 8 pounds per hour.

   (e) The use of any material, in any existing article, machine, equipment or other contrivance described in subsections 1, 2, 3, or 4, of this section G or the use of any material in any new or substantially modified article, machine, equipment, or other contrivance described in these sections, if the organic solvent or any material containing organic solvent does not come into direct contact with flame, and if the total volatile content of the material is not photochemically reactive as defined in section 10 of this regulation, and it meets any one of the following conditions:

      (i) The total volatile content contains not more than 20% by weight organic solvent, and the remainder consists only of water, or

      (ii) the total volatile content does not exceed 20% by weight, and a substantial portion of which evaporates before reaching the first heated zone, or

      (iii) the total volatile content does not exceed 5% by weight.

9. For the purposes of this section G, organic solvents include diluents and thinners and are defined as organic materials which are liquids at standard conditions and which are used as dissolvers, viscosity reducers or cleaning agents, except that such materials which exhibit a boiling point higher than 220°F at 0.5 millimeter mercury absolute pressure or having an equivalent vapor pressure shall not be considered to be solvents unless exposed to temperatures exceeding 220°F.

10. For the purposes of this Regulation No. 7, a photochemically reactive solvent is any solvent with an aggregate of more than 20 percent of its total weight composed of the chemical compounds classified below or which exceeds any of the following individual percentage composition limitations, referred to the total weight of solvent.

   (a) A combination of hydrocarbons, alcohols, aldehydes, esters, ethers, or ketones having an olefinic or cyclo-olefinic type of unsaturation: 5 percent;

   (b) A combination of aromatic compounds with eight or more carbon atoms to the molecule, except ethylbenzene: 8 percent;

   (c) A combination of ethylbenzene, ketones having branched hydrocarbon structures, trichloroethylene or toluene: 20 percent.

   Whenever any organic solvent or any constituent of an organic solvent may be classified from its chemical structure into more than one of the above groups of organic compounds, it shall be considered as a member of the most reactive chemical group, that is, that group having the least allowable percent of the total volume of solvents.

11. For the purposes of this section G, organic materials are defined as chemical compounds of carbon excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides, metallic carbonates, and ammonium carbonate.

   For the purpose of this section G the terms "baked, heat cured, or heat polymerized" refer to coatings and other organic, solvent containing materials which:

   (a) have been heated in devices in which the air temperature exceeds 175°F (80°C), and

   (b) which have become insoluble in solvents in which they were soluble before being subjected to heat.

H. ARCHITECTURAL COATINGS:

   1. No person may sell or offer for sale for use in containers of one quart capacity or larger, any architectural coating containing photochemically reactive solvent, as defined in subsection 10 of section G of this regulation.

   2. No person may employ, apply, evaporate or dry any architectural coating, purchased in containers of one quart capacity or larger, containing photochemically reactive solvent, as defined in subsection 10 or section G of this regulation.

3. No person may thin or dilute any architectural coating with a photochemically reactive solvent, as defined in subsection 10 of section G of this regulation.

4. For the purposes of this section H, an architectural coating is defined as coating used for residential or commercial buildings and their appurtenances, or industrial buildings.

I. DISPOSAL AND EVAPORATION OF SOLVENTS:

No person may, during any one day, dispose of a total of 1 quart capacity or larger, any photochemically reactive solvent as defined in subsection 10 of section G of this regulation, or of any material containing 1 quart or more of any such photochemically reactive solvent by any means which will permit the evaporation of such solvent into the atmosphere.

J. DRY CLEANING SOLVENTS:

1. No person may operate a drycleaning operation unless the uncontrolled organic vapor emissions from such operation have been reduced by at least 85 percent. Drycleaning operations emitting less than 3 pounds per hour and less than 15 pounds per day of uncontrolled organic vapors are exempt from this section J.

2. Any owner or operator of a source subject to this section J shall achieve compliance with the requirements of subsection 1 of this section J by discontinuing the use of photochemically reactive solvents as defined in subsection 10 of section G of this regulation.

3. If incineration is used as a control technique, 90 percent or more of the carbon in the organic compounds being incinerated must be oxidized to carbon dioxide.

K. DEGREASING OPERATIONS:

No person may use for a degreasing operation any photochemically reactive solvent as defined in subsection 10 of section G of this regulation unless the emission of organic materials is controlled to less than 40 pounds per day or 8 pounds per hour.

L. EFFECTIVE DATE:

Except as otherwise stated in this regulation, said regulation shall become effective November 28, 1973, as to new sources of hydrocarbon vapor emissions and effective December 31, 1974 as to existing sources, except that acceptable compliance schedules and permit applications for all existing sources affected by this regulation must be received by the Division by no later than March 1, 1974.

NOTE: THE FOLLOWING DEFINITIONS ARE TO BE ADDED TO THE COMMON PROVISIONS REGULATIONS, SECTION I, ENTITLED, "DEFINITIONS."

Adopted : September 13, 1973
Effective Date: November 1973

AMENDMENT
TO
COMMON PROVISIONS REGULATIONS

I. DEFINITIONS:

DEGREASING	-	The operation of using an organic solvent as a surface cleaning agent prior to fabricating, surface coating, electroplating, or any other process.
DRYCLEANING	-	A process by which an organic solvent is used in the commercial cleaning of garments and other fabric material.
PETROLEUM DISTILLATE	-	Any finished and intermediate products which are manufactured in crude petroleum processing and finishing operations having a vapor pressure of 1.5 p.s.i.a. or greater including gasoline manufactured from any source or by using any process.
SUBMERGED FILL PIPE	-	Any gasoline or petroleum distillate tank fill pipe the discharge of which is entirely submerged when the liquid level is 6 inches above the bottom of the tank. "Submerged fill pipe," when applied to a tank which is loaded from the side, is defined as any fill pipe the discharge opening of which is entirely submerged when the liquid level is 18 inches above the bottom of the tank.

Adopted: November 27, 1973
Effective: May 1, 1974

REGULATION NO. 8

Regulation to Control the Emissions of Chemical Substances and Physical Agents

I. Effective Areas and Dates of Regulation:

This regulation shall apply statewide. This regulation shall become effective twenty (20) days following publication by mailing pursuant to Section 3-16-2(11)(k) C.R.S. 1963, as amended, for new air contamination sources and effective July 1, 1974 for existing sources.

II. Information Statement - New Sources:

No person shall construct a new, or modify an existing air contamination source which may emit one or more chemical substances or physical agents listed in Section IV of this Regulation No. 8 without first submitting to the Division pursuant to Regulation No. 3 - Permit System, acceptable information and preventive control measures, where necessary, for said agents and substances as follows:

A. Types and quantities of substances and agents to be emitted;

B. allowable emission rates from openings as determined in Section III of this regulation (show calculations);

C. frequency and duration of emissions;

D. potential contributions of agent and substance emissions to localized and air basin air pollution problems unless deemed unnecessary by the Division.

1. applicable climatic conditions and topographical features affecting emission diffusion;

2. existing density, proximity and expected growth of human and other habitation; and

3. the preventive steps to be taken, where necessary, to control agent and substance emissions and, if applicable, steps to prevent odor, photochemical reactivity, toxicity, and damage to materials.

III. Emission Limitations for New and Existing Sources:

A. No person shall cause or permit the emission of any chemical substance or physical agent listed in Section IV of this Regulation No. 8 as excerpted from the 1973 edition of "Threshold Limit Values" (TLV) as published by the American Conference of Governmental Industrial Hygienists (ACGIH) to exceed the allowable emission rate as determined herein:

1. For substances and agents with a "C" prefix, the allowable emission rate from any opening shall be determined as follows:

   > Multiply the Threshold Limit Value (mg/M^3) from Section IV of this regulation by the Factor "A" determined by using Table I.

2. For substances and agents without a "C" prefix the allowable emission rate from any opening shall be determined as follows:

   > First multiply the Threshold Limit Value (mg/M^3) from Section IV of this regulation by the Factor "A" determined by using Table I; then multiply by the excursion factor as determined by using Table II.

B. Application:

Only those substances and agents with numerical limit values on the list shall be subject to this Regulation No. 8.

C. Exemptions:

1. Gasoline and diesel-powered engines shall not be subject to this Regulation No. 8.
2. Carbon Dioxide
3. Oxides of Nitrogen from combustion processes under 500,000 BTU's/hr.
4. Sulfur Dioxide from this Regulation No. 8.

D. Relationship to Other Air Quality Control Regulations:

Any person subject to this regulation must also conform to the requirements of all other Commission regulations and meet the most stringent requirements when inconsistency or other requirements exist.

E. Sampling:

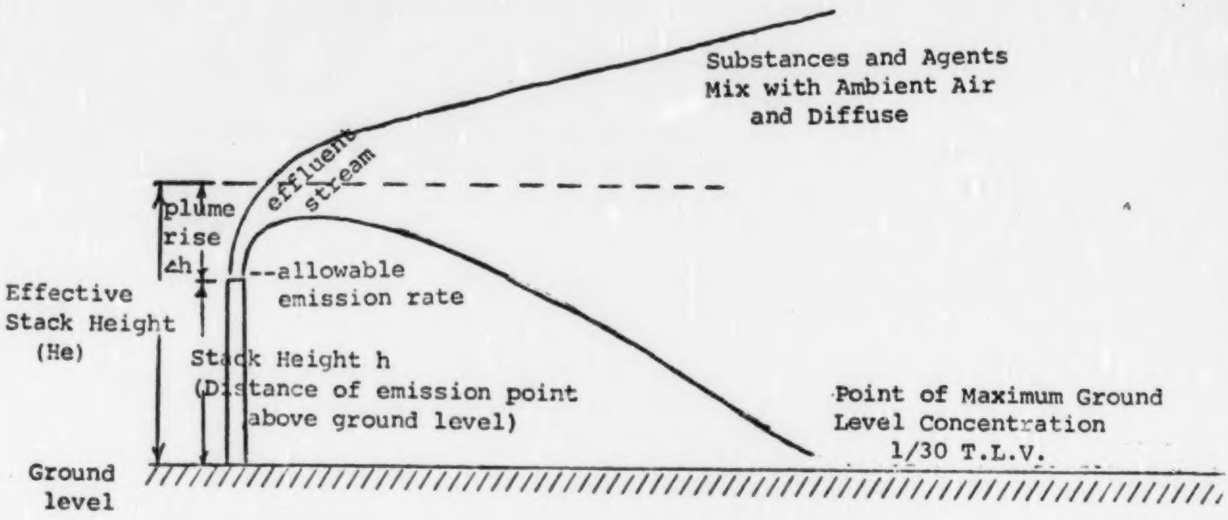
Sampling methods shall be subject to prior approval by the Division as specified by the Division of Laboratory Services, Colorado Department of Health.

TABLE I

PROCEDURE AND NOMOGRAPH FOR DETERMINING FACTOR "A"

Normally, the allowable emission rate of this Regulation No. 8 will not allow concentrations of substances and agents to exeed 1/30th of the T.L.V. at the ground level point of maximum concentration downwind from the emission point. The following Table for finding plume rise is based upon the Moses-Kraimer plume rise technique[1]. The nomograph simplifies an air pollution predictive modeling technique based upon the Pasquill-Gifford diffusion equation[2].

The following illustration identifies terms pertinent to determining Factor "A". It also shows emissions from an opening as a stack, diffusing with ambient air, until the emission-air mixture strikes ground level, the point of critical concern.


Substances and Agents Mix with Ambient Air and Diffuse
effluent stream
plume rise ∆h
--allowable emission rate
Effective Stack Height (He)
Stack Height h (Distance of emission point above ground level)
Point of Maximum Ground Level Concentration 1/30 T.L.V.
Ground level

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[1] "Moses-Kraimer Plume Rise Technique," Journal of the Air Pollution Control Association; Vol. 22, No. 8, August, 1972, pp 621-630

[2] "Pasquill-Gifford Diffusion Equation," Workbook of Atmospheric Diffusion Estimates, U.S.-H.E.W., PHS Pub. No. 99-AP 26, 1969

Data Needed:

1. h (stack height) being the height in meters (M) of point of emission into atmosphere above ground level.

2. Effluent flowrate being the flowrate in cubic meters per second (M^3/sec) of effluent gases, corrected to actual conditions exiting from the opening.

3. Temperature of effluent in degrees centigrade (°C-Celsuis).

Calculations Procedure:

1. Determine heat emission rate (Q_h) in kilocalories per second (Kcal/sec) as follows:

   $$Q_h = 0.25^* \times \text{Temp.}(^\circ C) \times \text{Flowrate, } (M^3/\text{sec})$$

   Note: Use Q_h = flowrate in M^3/sec if effluent temperature equals or is less than 0°C.

2. Determine plume rise (Δh) as follows:

Qh (Kcal/sec)	(h (M)
0 to but not including 100	11 meters
100 to but not including 1,000	46 meters
1,000 to but not including 10,000	54 meters
10,000 and above	251 meters

3. Determine effective stack height (He) in meters as follows:
   $He = h + \Delta h$

4. Determine Factor "A" (10^3M^3/sec) by entering Nomograph (Table I-A) with effective stack height (He) and left-hand side, then proceed horizontally to the right until Line one is intersected, then proceed vertically upward until Line two is intersected. Again proceed horizontally to the right and read off Factor "A" (10^3M^3/sec). If the effective stack height (h) is below twelve (12) meters, Factor "A" shall equal 0.034 (10^3M^3/sec).

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*Units of the constant 0.25 are $\frac{\text{Kcal}}{^\circ\text{C-M3}}$

TABLE I-A
TLV FACTOR "A" NOMOGRAPH

NOTE: For effective stack heights of less than 12 meters, Factor "A" equals 0.034.

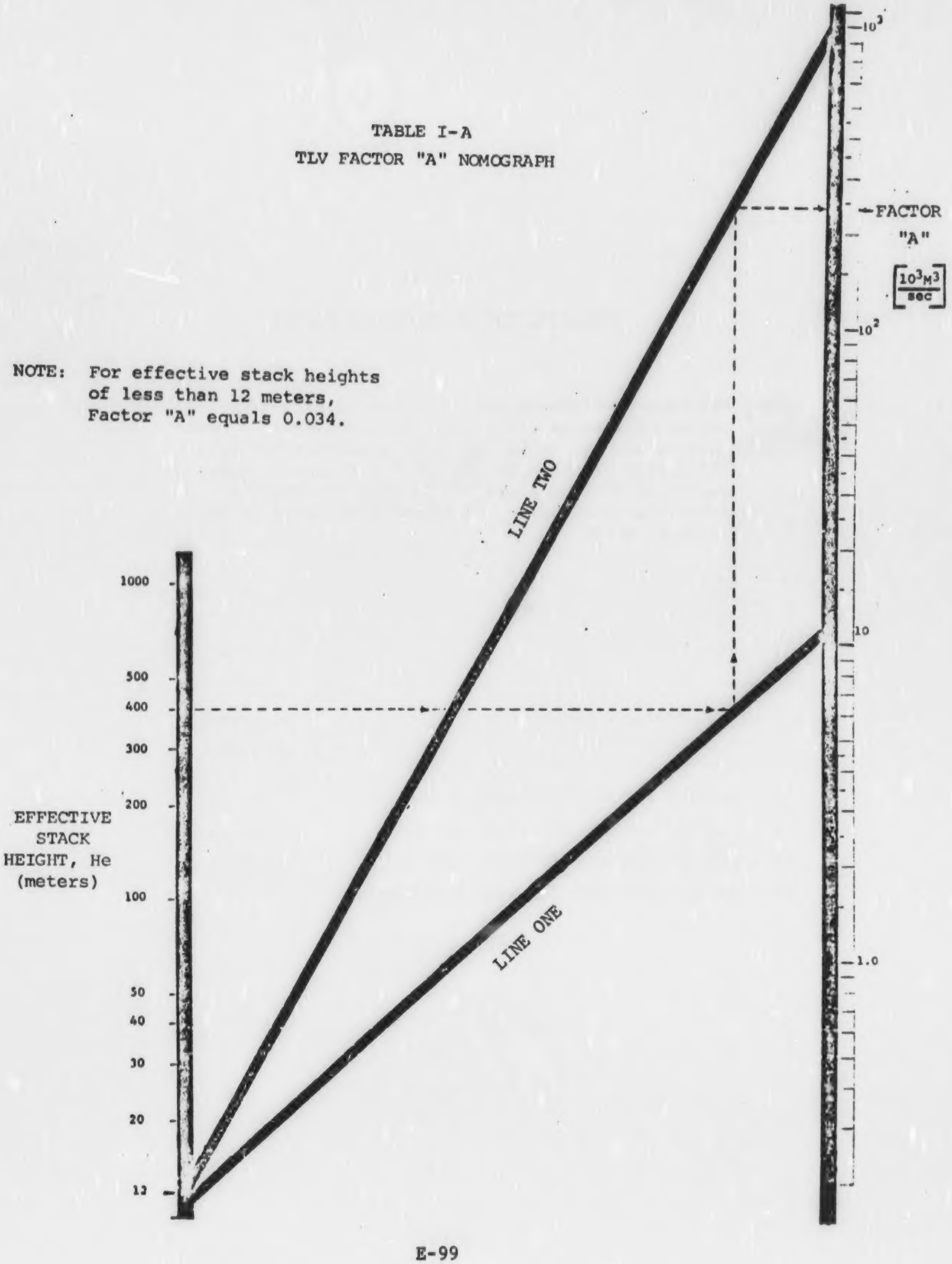

TABLE II

DETERMINATION OF EXCURSION FACTOR

Note: Excursion factors relate 7- or 8-hour exposures to maximum allowable short-term concentrations. These factors are not to be used with compounds having a "C" prefix as shown in the A.C.G.I.H. list. Also, excursion factors shall not be used if emission durations exceed nine (9) consecutive hours in any 24-hour period.

TLV IN mg/M^3 FROM SECTION IV OF THIS REGULATION NO. 8	EXCURSION FACTOR
0 - THROUGH BUT NOT INCLUDING 1 mg/M^3	3
1 - THROUGH BUT NOT INCLUDING 10 mg/M^3	2
10 - THROUGH BUT NOT INCLUDING 100 mg/M^3	1.5
100 - THROUGH BUT NOT INCLUDING 1,000 mg/M^3	1.25

ALLOWABLE EMISSION CALCULATION EXAMPLES

EXAMPLE ONE:

Given - Actual Stack Height (h) = 489 feet (149 meters*)
Stack Temperature = 160°C
Effluent Flowrate = 714.3 (M^3/sec)
Find - Allowable Emission Rate for Hydrogen Bromide (HBr)
Solution - 1. Determine Effective Stack Height

a. From Procedure No. 1, page 4 of this Regulation No. 8, heat emission rate becomes,

$$Qh = 0.25 \times \text{Temperature } (^{\circ}C) \times \text{effluent flowrate } (m^3/sec)$$
$$= 0.25\ (160^{\circ}C)(714.3\ m^3/sec)$$
$$= 28{,}572 \text{ Kilocalories/Second}$$

b. From Procedure No. 2, page 4,

$Qh = 28{,}572 \frac{(Kcal)}{(\ sec)}$ is greater than 10,000,

Therefore, Plumerise Δh = 251 meters.

c. From Procedure No. 3, page 4, effective stack height becomes,

$$He = h + \Delta h$$
$$= 149(M) + 251\ (M)$$
$$= 400 \text{ meters}$$

2. Enter Table I-A as shown. Proceeding horizontally to Line One then vertically to Line Two and again horizontally to the scale where Factor "A" is determined to be 2.4×10^2 or 240 ($10^3 M^3$/sec).

3. The TLV for HBr is 10 mg/M^3 as found on page 11 of this regulation. The excursion factor from Table II is 1.5 for 9-hour workdays.

4. The product (TLV)x(Excursion Factor)x(Factor A) equals:

10(1.5)(240) = 3600 g/sec
providing emissions do not continue
beyond 9 hours in any 24-hour period.

EXAMPLE TWO:

Given - Same conditions as Example One.
Find - Allowable emission concentration of Formaldehyde.
Solution - 1. Following a similar procedure, He, again equals 400 meters*
2. Again, this results in a Factor "A" of 240.
3. The TLV for Formaldehyde is 3 mg/M^3.
4. Formaldehyde has a "C" prefix, therefore the allowable emission rate equals:

(TLV) x (Factor "A") = (3)(240) = 720 g/sec

---

*1 meter equals 3.28 feet

IV. Affected Chemical Substances and Physical Agents:

A. Special Compounds (Use instead of T.L.V. list)

The following compounds shall be considered in a manner described in III.A.(2) of this Regulation No. 8. Values listed herein shall be substituted for a T.L.V. value in the prescribed calculation procedure. This compound shall be treated as a "C" value without application of excursion factors.

1. LEAD	0.04	mg/M^3	(USE AS A "C" PREFIX LIMIT)
2. G.B. NERVE AGENT	0.0009	mg/M^3	(USE AS A "C" PREFIX LIMIT)
3. MUSTARD	0.042	mg/M^3	(USE AS A "C" PREFIX LIMIT)

B. In addition to the requirements of IV.A., the following shall apply to G.B. Nerve Agent and Mustard Gas:

No person shall cause or permit emissions of the following substances from any opening to exceed the limits listed below:

Air Contaminants	Maximum Concentration	Time	Relation to T.L.V.
G.B. Nerve Agent (methylisopropoxyfluorophosphine oxide)	0.003 mg/M^3	2-hr	No T.L.V.
Mustard (dichlorodiethyl sulfide)	0.03 mg/M^3	1-hr	No T.L.V.

ADOPTED AT THE 35TH ANNUAL MEETING OF THE AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS - BOSTON, MASSACHUSETTS, MAY 21 - 25, 1973

ADOPTED VALUES (in Alphabetic Order)

	Substance	ppm[a)]	mg/M^3[b)]
	Abate	-	10
+	Acetaldehyde	100	180
	Acetic acid	10	25
+C	Acetic anhydride	5	20
	Acetone	1,000	2,400
	Acetonitrile	40	70
	2-Acetylaminofluorene - Skin	-	A[2]
	Acetylene	F	-
	Acetylene dichloride, see 1, 2-Dichloroethylene	-	-
	Acetylene tetrabromide	1	14
	Acrolein	0.1	0.25
	Acrylamide - Skin	-	0.3
	Acrylonitrile - Skin	20	45
	Aldrin - Skin	-	0.25
	Allyl alcohol - Skin	2	3
	Allyl chloride	1	5
*C	Allyl glycidyl ether (AGE)	(10)	(45)
	Allyl propyl disulfide	2	12
	Alundum (Al_2O_3)	-	E
	4-Aminodiphenyl - Skin	-	A[1b]
	2-Aminoethanol, see Ethanolamine	-	-
	2-Aminopyridine	0.5	2
+	Ammonia	25	18
*	Ammonium chloride, fume	-	10
	Ammonium sulfamate (Ammate)	-	10
	n-Amyl acetate	100	525
	sec-Amyl acetate	125	650

	Substance	ppm[a)]	mg/M^3[b)]
	Aniline - Skin	5	19
	Anisidine(o, p-isomers) - Skin	-	0.5
	Antimony & compounds (as Sb)	-	0.5
	ANTU(alpha naphthyl thiourea)	-	0.3
	Argon	F	-
	Arsenic & compounds (as As)	-	0.5
	Arsine	0.05	0.2
	Asphalt (petroleum) fumes	-	5
	Azinphos methyl - Skin	-	0.2
	Barium (soluble compounds)	-	0.5
C	Benzene(benzol) - Skin	25	80
	Benzidine - Skin	-	A[1b]
	p-Benzoquinone, see Quinone	-	-
	Benzoyl peroxide	-	5
	Benzyl chloride	1	5
	Berylium	-	0.002
+	Bismuth telluride	-	10
+	Bismuth telluride(se-doped)	-	5
	Biphenyl, see Diphenyl	-	-
	Boron oxide	-	10
	Boron tribromide	1	10
C	Boron trifluoride	1	3
	Bromine	0.1	0.7
	Bromine pentafluoride	0.1	0.7

	Substance	ppm$^{a)}$	mg/M$^{3\ b)}$
	Bromoform - Skin	0.5	5
	Butadiene (1,3-butadiene)	1,000	2,200
+	Butane	500	1,200
	Butanethiol, see Butyl mercaptan	-	-
	2-Butanone	200	590
	2-Butoxy ethanol (Butyl Cellosolve) Skin	50	240
	Butyl acetate (n-butyl acetate)	150	710
	sec-Butyl acetate	200	950
	tert-Butyl acetate	200	950
	Butyl alcohol	100	300
	sec-Butyl alcohol	150	450
	tert-Butyl alcohol	100	300
C	Butylamine -Skin	5	15
C	tert-Butyl chromate (asCrO_3) - Skin	-	0.1
	n-Butyl glycidyl ether (BGE)	50	270
	Butyl mercaptan	0.5	1.5
	p-tert-Butyltoluene	10	60
	Cadmium (Metal dust and soluble salts)	-	0.2
** C	Cadmium oxide fume (as Cd)	-	0.1
	Calcium carbonate	-	E
	Calcium arsenate	-	1
	Calcium oxide	-	5
	Camphor (Synthetic)	2	12
	Carbaryl (Sevin^{R})	-	5
	Carbon black	-	3.5
**	Carbon dioxide	5,000	9,000
	Carbon disulfide - Skin	20	60
	Carbon monixide	50	55
	Carbon tetrachloride - Skin	10	65
	Cellulose (paper fiber)	-	E
	Chlordane - Skin	-	0.5
	Chlorinated camphene - Skin	-	0.5
	Chlorinated diphenyl oxide	-	0.5
	Chlorine	1	3
	Chlorine dioxide	0.1	0.3
C	Chlorine trifluoride	0.1	0.4
C	Chloroacetaldehyde	1	3

	Substance	ppm$^{a)}$	mg/M$^{3\ b)}$
	α-Chloroacetophenone (phenacylchloride)	0.05	0.3
	Chlorobenzene (monochlorobenzene)	75	350
	o-Chlorobenzylidene malononitrile (OCBM) - Skin	0.05	0.4
	Chlorobromomethane	200	1,050
	2-Chloro-1,3-butadiene, see Chloroprene	-	-
	Chlorodiphenyl (42% Chlorine) - Skin	-	1
	Chlorodiphenyl (54% Chlorine) - Skin	-	0.5
	1-Chloro, 2,3-epoxypropane, see Epichlorhydrin	-	-
	2-Chloroethanol, see Ethylene chlorohydrin	-	-
	Chloroethylene, see Vinyl chloride	-	-
+ C	Chloroform (trichloromethane)	25	120
	1-Chloro-1-nitropropane	20	100
	Chloropicrin	0.1	0.7
	Chloroprene (2-chloro-1, 3-butadiene) - Skin	25	90
	Chromic acid and chromates (as CrO_3)	-	0.1
	Chromium, sol. chromic, chromous salts as Cr	-	0.5
**	Metal & insol. salts	A^{1a}	(1.0)
+	Coal dust (Bituminous) (Respirable dust fraction 5% quartz)(If 5% quartz use respirable mass formulas	-	2
	Coal tar pitch volatiles (benzene soluble fraction) anthracene, BaP, phenanthrene, acridine, chrysene, pyrene)	A^{1a}	0.2
	Cobalt, metal fume and dust	-	0.1

	Substance	ppm a)	mg/M^3 b)
**	Copper fume	-	0.1
	Dusts and Mists	-	1
	Corumdum (Al_2O_3)	-	E
**	Cotton Dust (raw)	-	(1)
	Crag^R herbicide	-	10
	Cresol(all isomers) Skin	5	22
	Crotonaldehyde	2	6
	Cumene - Skin	50	245
	Cyanide (as CN)- Skin	-	5
	Cyanogen	10	-
	Cyclohexane	300	1,050
	Cyclohexanol	50	200
	Cyclohexanone	50	200
	Cyclohexene	300	1,015
	Cyclopentadiene	75	200
	2,4-D	-	10
	DDT	-	1
	DDVP, see Dichlorvos	-	-
	Decaborane - Skin	0.05	0.3
	Demeton^R - Skin	-	0.1
	Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone)	50	240
	1,2-Diaminoethane, see Ethylenediamine	-	-
	Diazinon - Skin	-	0.1
	Diazomethane	0.2	0.4
	Diborane	0.1	0.1
**	1,2-Dibromoethane (ethylene dibromide) -Skin	20	145
	Dibrom^R	-	3
*	2-N Dibutylamino-ethanol - Skin	2	14
	Dibutyl phosphate	1	5
	Dibutylphthalate	-	5
C	Dichloracetylene	0.1	0.4
C	O-Dichlorobenzene	50	300
	p-Dichlorobenzene	75	450
**	Dicholorbenzidine - Skin	-	A^{1b}
	Dichlorodifluoromethane	1,000	4,950

	Substance	ppm a)	mg/M^3 b)
	1,3-Dichloro-5,5-dimethyl hydantoin	-	0.2
+	1,1-Dichloroethane	200	820
	1,2-Dichloroethane	50	200
	1,2-Dichloroethylene	200	790
+	Dichloroethyl ether Skin	5	30
	Dichloromethane, see Methylene chloride	--	-
	Dichloromonofluoromethane	1,000	4,200
	Cl,1-Dichloro-1-nitroethane	10	60
	1,2-Dichloropropane, see Propylene-dichloride	-	-
	Dichlorotetrafluoroethane	1,000	7,000
	Dichlorvos (DDVP) Skin	-	1
	Dieldrin - Skin	-	0.25
	Diethylamine	25	75
	Diethylamino ethanol - Skin	10	50
*	Diethylene triamine - Skin	1	4
	Diethylether, see Ethyl ether	-	-
	Difluorodibromomethane	100	860
C	Diglycidyl ether (DGE)	0.5	2.8
	Dihydroxybenzene, see Hydroquinone	-	-
+	Diisobutyl ketone	25	150
	Diisopropylamine-Skin	5	20
	Dimethoxymethane, see Methylal	-	-
	Dimethyl acetamide - Skin	10	35
	Dimethylamine	10	18
	4-Dimethylaminoazobenzene	-	A^2
	Dimethylaminobenzene, see Xylidene	-	-

Substance	ppm[a]	mg/M^3[b]
Dimethylaniline (N-dimethylaniline) Skin	5	25
Dimethylbenzene, see Xylene	-	-
Dimethyl 1, 2-dibromo-2-dichloroethyl phosphate, see DiBrom	-	-
Dimethylformamide - Skin	10	30
2,6-Dimethylheptanone, see Diisobutyl ketone	-	-
1,1-Dimethylhydrazine -Skin	0.5	1
Dimethylphthalate	-	5
** Dimethylsulfate-Skin	(1)	(5)
Dinitrobenzene (all isomers)- Skin	-	1
Dinitro-o-cresol - Skin	-	0.2
Dinitroltoluene - Skin	-	1.5
** Dioxane (Diethylene dioxide_ -Skin	100	360
Diphenyl	0.2	1
Diphenyl amino	-	10
Diphenylmethane diisocyanate(see Methylene bisphenyl isocyanate (MDI)	-	-
Dipropylene glycol methyl ether - Skin	100	600
+ Diquat	-	.05
Si-sec, octyl phthalate (Di-2-ethylhexylphthalate)	-	5
Emery	-	E
Endosulfan (Thiodan^R)- Skin	-	0.1
Endrin - Skin	-	0.1
Epichlorhydrin- Skin	5	19
EPN -Skin	-	0.5
1,2-Epoxypropane, see Propyleneoxide	-	-
2,3-Epoxy-1-propanol, see Glycidol	-	-
Ethane	F	-
Ethanethiol, see Ethylmercaptan	-	-
Ethanolamine	3	6
+ 2-Ethoxyethanol - Skin	100	370
2-Ethoxyethylacetate (Cellosolve acetate - Skin	100	540
Ethyl acetate	400	1,400
Ethyl acrylate - Skin	25	100
Ethyl alcohol (ethanol)	1,000	1,900
Ethylamine	10	18
Ethyl sec-amyl ketone (5-methyl-3-heptanone)	25	130
Ethyl benzene	100	435
Ethyl bromide	200	890
Ethyl butyl ketone (3-Heptanone)	50	230
Ethyl chloride	1,000	2,600
Ethyl ether	400	1,200
Ethyl formate	100	300
Ethyl mercaptan	0.5	1
Ethyl silicate	100	850
Ethylene	F	-
Ethylene chlorohydrin - Skin	5	16
Ethylenediamine	10	25
Ethylene dibromide, see, 1,2-Dibromoethane	-	-
Ethylene dichloride, see, 1,2-Dichloroethane	-	-
C Ethylene glycol dinitrate and/or Nitroglycerin- Skin	0.2[d]	-
Ethylene glycol monomethyl ether acetate (Methyl cellosolve acetate) -Skin	25	120
Ethylene imine - Skin	0.5	1
Ethylene oxide	50	90
Ethylidine chloride, see 1, 1-Dichloroethane	-	-
N-Ethylmorpholine-Skin	20	94

	Substance	ppm a)	mg/M^3 b)
	Ferbam	-	10
	Ferrovanadium dust	-	1
	Fluoride (as F)	-	2.5
+	Fluorine	1	2
	Fluorotrichloromethane	1,000	5,600
* C	Formaldehyde	2	3
	Formic acid	5	9
	Furfural - Skin	5	20
	Furfuryl alcohol	(50)	(200)
	Gasoline	-	B^2
+	Germanium tetrahydride (Germane)	0.2	0.6
	Glass, fibrous e) or dust	-	E
	Glycerin mist	-	E
	Glycidol (2,3 epoxy-1-propanol)	50	150
	Glycol monoethyl ether, see 2-Ethoxyethanol	-	-
	Graphite, (Synthetic)	-	E
	Guthion,^{R} see Azinphos-methyl	-	-
	Gypsum	-	E
	Hafnium	-	0.5
	Helium	F	-
	Heptachlor - Skin	-	0.5
	Heptane (n-heptane)	500	2,000
	Hexachloroethane - Skin	1	10
	Hexachloronaphthalene -Skin	-	0.2
	Hexafluoroacetone	0.1	0.7
	Hexane (n-hexane	500	1,800
	2-Hexanone	100	410
	Hexone (Methyl isobutyl ketone)	100	410
	sec-Hexyl acetate	50	300
	Hydrazine - Skin	1	1.3
	Hydrogen	F	-
	Hydrogen bromide	3	10
C	Hydrogen chloride	5	7
	Hydrogen cyanide - Skin	10	11
	Hydrogen fluoride	3	2
	Hydrogen peroxide	1	1.4
	Hydrogen selenide	0.05	0.2
	Hydrogen sulfide	10	15
	Hydroquinone	-	2

	Substance	ppm a)	mg/M^3 b)
	Indene	10	45
	Indium and compounds, as In	-	0.1
C	Iodine	0.1	1
**	Iron oxide fume	-	10
*	Iron pentacarbonyl	0.01	0.08
	Iron salts, soluble, as Fe	-	1
	Isoamyl acetate	100	525
	Isoamyl alcohol	100	360
	Isobutyl acetate	150	700
	Isobutyl alcohol	100	300
**	Isophorone	-	-
	Isopropyl acetate	250	950
	Isopropyl alcohol	400	980
	Isopropylamine	5	12
+	Isopropylether	250	1,050
	Isopropyl glycidyl ether (IGE)	50	240
	Kaolin	-	E
	Ketene	0.5	0.9
	Lead	-	0.15
	Lead arsenate	-	0.15
	Limestone	-	E
	Lindane	-	0.5
	Lithium hydride	-	0.025
	L.P.G. (Liquified petroleum gas)	1,000	1,800 1,800
	Magnesite	-	E
	Magnesium oxide fume	-	10
	Malathion -Skin	-	10
	Maleic anhydride	0.25	1
C	Manganese and compounds, as Mn	-	5
	Marble	-	E
	Mercury (Alkyl compounds - Skin	-	0.01
	Mercury (All forms except alkyl)	-	0.05
	Mesityl oxide	25	100
	Methane	F	-
	Methanethiol, see Methyl mercaptan	-	-
	Methoxychlor	-	10
	2-Methoxyethanol - Skin (Methyl cellosolve)	25	80

Substance	ppm a)	mg/M^3 b)
Methyl acetate	200	610
Methyl acetylene (propyne)	1,000	1,650
Methyl acetylene-propadiene mixture (MAPP)	1,000	1,800
Methyl acrylate - Skin	10	35
+ Methylacrylonitrile-Skin	1	3
Methylal (dimethoxy-methane	1,000	3,100
Methyl alcohol (methanol)	200	260
Methylamine	10	12
Methyl amyl alcohol, see Methyl isobutyl carbinol	-	-
Methyl 2-cyanoacrylate	2	8
Methyl isoamyl ketone (2-Heptanone)	100	475
Methyl bromide - Skin	-	465
Methyl butyl ketone, see 2-Hexanone	-	-
Methyl cellosolve - Skin see 2-Methoxyethanol	-	-
Methyl cellosolve acetate - Skin see Ethylene glycol monomethyl ether acetate	-	-
Methyl chloride	100	210
Methyl chloroform	350	1,900
Methylcyclohexane	500	2,000
Methylcyclohexanol	50	235
o-Methylcyclohexanone - Skin		230
Methylcyclopentadienyl manganese tricarbonyl(as Mn) - Skin	0.1	0.2
Methyl demeton - Skin	-	0.5
Methyl ethyl ketone (MEK), see 2-Butanone	-	-
Methyl formate	100	250
Methyl iodide - Skin	5	28

Substance	ppm a)	mg/M^3 b)
Methyl isobutyl carbinol - Skin	25	100
Methyl isobutyl ketone, see Hexone	-	-
Methyl isocyanate-Skin	0.02	0.05
Methyl mercaptan	0.5	1
Methyl methacrylate	100	410
Methyl parathion Skin	-	0.2
Methyl propyl ketone, see 2-Pentanone	-	-
C Methyl silicate	5	30
C x Methyl styrene	100	480
C Methylene bisphenyl isocyanate (MDI)	0.02	0.2
Methylene chloride (dichloromethane)	(500)	(1,740)
Molybdenum		
(soluble compounds)	-	5
(insoluble compounds)	-	10
Monomethyl aniline Skin	2	9
C Monomethyl hydrazine-Skin	0.2	0.35
Morpholine - Skin	20	70
Naphtha (coal tar)	100	400
Naphthalene	10	50
B-Naphthylamine	-	A[1b]
Neon	F	-
Nickel carbonyl	0.001A[1a]	0.007
Nickel, metal and soluble compounds (as Ni)	-	1
Nicotine - Skin	-	0.5
Nitric acid	2	5
Nitirc oxide	25	30
p-Nitroaniline - Skin	1	6
Nitrobenzene - Skin	1	5
p-Nitrochlorobenzene - Skin	-	1

Substance	ppm$^{a)}$	mg/M$^{3\,b)}$
4-Nitrodiphenyl	-	A^{1a}
Nitroethane	100	310
Nitrogen	F	-
C Nitrogen dioxide	5	9
Nitrogen trifluoride	10	29
Nitroglycerin - Skin	0.2	2
Nitromethane	100	250
1-Nitropropane	25	90
2-Nitropropane	25	90
N-Nitrosodimethylamine (dimethylnitrosoamine) - Skin	-	A^{2}
Nitrotoluene - Skin	5	30
Nitrotrichloromethane, see Chloropicrin	-	-
Nitrous oxide	F	-
Octochloronaphthalene - Skin	-	0.1
Octane	400	1,900
Oil mist, particulate	-	5$^{f)}$
Oil mist, vapor	$^{g)}$B^{2}	-
Osmium tetroxide	-	0.002
Oxalic acid	-	1
Oxygen difluoride	0.05	0.1
Ozone	0.1	0.2
Paraquat - Skin	-	0.5
Parathion - Skin	-	0.1
Perlite	-mppcf	30
Pentaborane	0.005	0.01
Pentachloronaphthalene - Skin	-	0.5
Pentachlorophenol -Skin	-	0.5
Pentaerythritol	-	E
Pentane	500	1,500
2-Pentanone	200	700
Perchlorethylene	100	670
Perchloromethyl mercaptan	0.1	0.8
Perchoryl fluoride	3	14

Substance	ppm$^{a)}$	mg/M$^{3\,b)}$
Petroleum distillates (naphtha)	$^{g)}$B^{2}	-
Phenol - Skin	5	19
p-Phenylene diamine - Skin	-	0.1
Phenyl ether (vapor)	1	7
Phenyl ether-Diphenyl mixture (vapor)	1	7
Phenylethylene, see Styrene	-	-
Phenyl glycidyl ether (PGE)	10	60
Phenylhydrazine - Skin	5	22
Phenothiazine - Skin	-	5
Phosdrin (Mevinphos)^{R} - Skin	-	0.1
Phosgene (carbonyl chloride)	0.1	0.4
Phosphine	0.3	0.4
Phosphoric acid	-	1
Phosphorus (yellow)	-	0.1
Phosphorus pentachloride	-	1
Phosphorus pentasulfide	-	1
Phosphorus trichloride	0.5	3
Phtalic anhydride	2	12
Picric acid - Skin	-	0.1
Pival^{R} (2-Pivalyl-1,3-indandione)	-	0.1
Plaster of Paris	-	E
Platinum (Soluble Salts) as Pt	-	0.002
Polychlorobiphenyls, see Chlorodiphenyls	-	-
Polytetrafluoroethylene decomposition products	-	B^{1}

Substance	ppm$^{a)}$	mg/M^{3} $^{b)}$
Propane	F	-
B Propiolactone	-	A^2
Propargyl alcohol - Skin	1	-
n-Propyl acetate	200	840
Propyl alcohol	200	500
n-Propyl nitrate	25	110
Propylene dichloride (1,2-Dichloropropane)	75	350
* Propylene glycol monomethyl ether	100	360
Propylene imine - Skin	2	5
Propylene oxide	100	240
Propyne, see Methylacetylene	-	-
Pyrethrum	-	5
Pyridine	5	15
Quinone	0.1	0.4
RDX - Skin	-	1.5
Rhodium, Metal fume and dusts (as Rh)	-	0.1
Soluble salts	-	0.001
Ronnel	-	10
* Rosin Core Solder, Pryolysis products (as formaldehyde)	-	0.1
Rotenone(commercial)	-	5
Rouge	-	E
Selenium compounds (as Se)	-	0.2
Selenium hexafluoride	0.05	0.4
+ Silicon	-	10
Silicon carbide	-	E
Silver, metal and soluble compounds	-	0.01
Sodium fluoroacetate (1080) - Skin	-	0.05
** Sodium hydroxide	-	2
Starch	-	E
Stibine	0.1	0.5
Stoddard solvent	200	1,150
Strychnine	-	0.15
+C Subtillsins(Proteolytic enzymes as 100% pure crystalline enzyme)	-	0.0003

Substance	ppm$^{a)}$	mg/M^{3} $^{b)}$
Styrene (Monomer) (Phenyl ethylene)	100	420
Sucrose	-	E
Sulfur dioxide	5	13
Sulfur hexafluoride	1,000	6,000
Sulfuric acid	-	1
Sulfur monochloride	1	6
Sulfur pentafluoride	0.025	0.25
+Sulfur tetrafluoride	0.1	0.4
Sulfuryl fluoride	5	20
Systox, see Demeton^R	-	-
2,4,5T	-	10
Tantalum	-	5
TEDP - Skin	-	0.2
Teflon^R decomposition products	-	B^1
Tellurium	-	0.1
Tellurium hexafluoride	0.02	0.2
TEPP - Skin	-	0.05
C Terphenyls	1	9
1,1,1,2-Tetrachloro-2, 2-difluoroethane	500	4,170
1,1,2,2-Tetrachloro-1, 2-difluorethan	500	4,170
1,1,2,2-Tetrachloro-ethane Skin	5	35
Tetrachloroethylene, see Perchloroethylene	-	-
Tetrachloromethane, see Carbon tetrachloride	-	-
Tetrachloronaphthalene-Skin	-	2

Substance	ppm a)	mg/M^3 b)
Tetraethyl lead (as Pb) - Skin	-	0.100 h)
Tetrahydrofuran	200	590
Tetramethyl lead (as Pb) Skin	-	0.150 h)
Tetramethyl succinonitrile - Skin	0.5	3
Tetranitromethane	1	8
Tetryl (2,4,6-trinitrophenyl-methylnitrmine) - Skin	-	1.5
Thallium (soluble compounds) - Skin (as Ti)	-	0.1
Thiram^R	-	5
Tin (inorganic compounds, except SnH_4 and SnO_2) as Sn	-	2
Tin (organic compounds) - Skin (as Sn)	-	0.1
Tin oxide	-	E
Titanium dioxide	-	E
+ Toluene	100	375
C Toluene- 2,4-diisocyanate	0.02	0.14
o-Toluidine	5	22
Toxaphene, see Chlorinated camphene	-	-
Tributyl phosphate	-	5
1,1,1-Trichloroethane, see Methyl chloroform	-	-
1,1,2-Trichloro ethane - Skin	10	45
Trichloroethylene	100	535
Trichloromethane, see Chloroform	-	-
Trichloronapthalane- Skin	-	5
1,2,3-Trichloropropane	50	300
1,1,2-Trichloro-1,2,2-trifluoroethane	1,000	7,600
Triethylamine	25	100
Trifluoromonobromomethane	1,000	6,100
Trimethyl benzene	25	120
2,4,6-Trinitrophenol, see Picric acid	-	-
2,4,6-Trinitrophenyl-methylnitramine, see Tetryl	-	-
Trinitrotoluene - Skin	-	1.5
Triorthocresyl phosphate	-	0.1
Triphenyl phosphate	-	3
Tungsten and compounds, as W		
Soluble	-	1
Insoluble	-	5
Turpentine	100	560
Uranium (natural) soluble and insoluble compounds, as U	-	0.2
Vanadium (V_2O_5), as V		
Dust	-	0.5
* C Fume	-	0.05
Vinyl acetate	10	30
Vinyl benzene, see Styrene	-	-
* Vinyl bromide	250	1,100
Vinyl chloride	200	770
Vinylcyanide, see Acrylonitrile	-	-
Vinyl toluene	100	480
Warfarin	-	0.1
* Wood dust (nonallergenic)	-	5

Substance	ppm[a)]	mg/M^3
Xylene(xylol)	100	435
Xylidine - Skin	5	25
Yttrium	-	1
Zinc chloride fume	-	1
Zinc oxide fume	-	5
Zirconium compounds (as Zr)	-	5

ppm Parts of vapor or gas per million parts of contaminated air by volume at 25°C and 760 mm. Hg. pressure.

mg/M^3 Approximate milligrams of substance per cubic meter of air.

NOTES

Capital letters refer to appendices
* 1972 Addition
** See notice of intended changes
+ 1973 Addition
a) Parts of vapor or gas per million parts of contaminated air by volume at 25°C and 760 mm. Hg. pressure.
b) Approximate milligrams of substance per cubic meter of air.
d) An atmospheric concentration of not more than 0.02 ppm, or personal protection may be necessary to avoid headache.
e) $<$ 5-7 um in diameter
f) As sampled by method that does not collect vapor.
g) According to analytically determined composition.
h) For control of general room air, biologic monitoring is essential for personnel control.

CHANGES IN ADOPTED VALUES - TENTATIVE LISTINGS

All changes that are recommended are based on documented evidence which is available from the chairman.

Substance	From	To
Cadmium oxide fume	0.2 mg/m^3	C 0.05 mg/m^3
Carbon dioxide	Documentation to permit TLV of 15,000 ppm provided certain stipulated medical criteria are met.	
bisChloroethyl ether	C 15 ppm	5 ppm
Copper fume	0.1 mg/m^3	0.2 mg/m^3
Iron Oxide fume	10 mg/m^3	5 mg/m^3
Paraffin wax fume	1 mg/m^3	2 mg/m^3
Sodium hydroxide	2 mg/m^3	C 2 mg/m^3

NOTICE OF INTENDED CHANGES - MINERAL DUSTS

Substance	TLV
Asbestos (All types)	5 fibers/ml > 5 in length n) A^{1a}
+Silica flour	Use respirable mass formula for quartz
+Tripoli	Use respirable mass formula for quartz

n) As determined by the membrane filter method at 400-450 X magnification (4 mm objective) phase contrast illumination. Concentrations 5 fibers/ml but not to exceed 10, may be permitted for 15-minute periods each hour up to five times daily.

+1972 Revision or Addition

NOTICE OF INTENDED CHANGES
APPENDIX A

Carcinogens

The Committee lists below those substances in industrial use that have proven carcinogenic in man or have induced cancer in animals under experimental conditions. Present listing of those substances carcinogenic for man takes two forms, those for which a TLV has been assigned (1a), and those for which environmental conditions have not been sufficiently defined to assign at TLV (1b).

1a. Human Carcinogens - Substances known to be occupational carcinogens with an assigned TLV: Asbestos, 5 fibers/cc > 5 μm in length; certain insoluble chromates, 0.1 mg/m^3; Coal tar pitch volatiles, 200 ppb; Nickel carbonyl, 1 ppb.

1b Human Carcinogens - Substances known to be occupational carcinogens without an assigned TLV:

4-Aminodiphenyl
Benzidine & its salts
bis-Chloromethyl ether
Chloromethyl ether
beta-Naphthylamine
4-Nitrodiphenyl

For the substances in 1 b, no exposure or contact by any route, respiratory, skin or oral, as detected by the most sensitive methods, shall be permitted. "No exposure contact" means hermitizing the process or operation by the best practicable engineering methods, and protecting the worker by proper equipment that will insure virtually no contact or entry of the carcinogen by any route.

2. Experimental Carcinogens - Industrial substances found to be of high potency in inducing tumors under experimental conditions in animals:

2-Acetylaminofluorene
3,3'-Dichlorobenzidine
4-Dimethylaminoazobenzene
Dimethyl sulfate
Ethylenimine
4,4'-Methylene bis(2-Chloroaniline)
N-Nitrosodimethylamine
beta-Propiolactone

For the above, worker exposure by all routes should be reduced to a minimum in light of the warning of the potency of these substances to induce tumors in animals. "Reduced to a minimum" means extraordinary care shall be taken both in manufacture and in handling so that worker exposure by all routes is kept to an irreducible minimum.

APPENDIX B

B^1 Polytetrafluoroethylene* Decomposition products. Thermal decomposition of the fluorocarbon chain in air leads to the formation of oxidized products containing carbon, fluorine and oxygen. Because these products decompose in part by hydrolysis in alkaline solution, they can be quantitatively determined in air as fluoride to provide an index of exposure. No TLV is recommended pending determination of the toxicity of the products, but air concentrations should be minimal.

B^2 Gasoline and/or Petroleum Distillates: The composition of these materials varies greatly and thus a single TLV for all types of these materials is no longer applicable. In general, the aromatic hydrocarbon content will determine what TLV applies. Consequently the content of benzene, other aromatics and additives should be determined to arrive at the appropriate TLV (Elkins, et al. A.I.H.A.J. 24:99,1963).

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*Trade Names: Algoflon, Fluon, Halon, Teflon, Tetran

APPENDIX C

B.1 THRESHOLD LIMIT VALUES FOR MIXTURES:

When two or more hazardous substances are present, their combined effect, rather than that of either individually, should be given primary consideration. In the absence of information to the contrary, the effects of the different hazards should be considered as additive. That is, if the sum of the following fractions

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \dots \frac{C_n}{T_n}$$

exceeds unity, then the threshold limit of the mixture should be considered as being exceeded. C_1 indicates the observed atmospheric concentration, and T_1 the corresponding threshold limit (See Example 1A.a. and 1A.c.).

Exceptions to the above rule may be made when there is good reason to believe that the chief effects of the different harmful substances are not in fact additive, but independent as when purely local effects on different organs of the body are produced by the various components of the mixture. In such cases the threshold limit ordinarily is exceeded only when at least one member of the series

$$\left(\frac{C_1}{T_1} + \text{ or } \frac{+C_2}{T_2} \text{ etc.} \right)$$

itself has a value exceeding unity (See Example 1 A.c.).

Antagonistic action or potentiation may occur with some combinations of atmospheric contaminants. Such cases at present must be determined individually. Potentiating or antagonistic agents are not necessarily harmful by themselves. Potentiating effects of exposure to such agents by routes other than that of inhalation is also possible, e.g. imbibed alcohol and inhaled narcotic (trichloroethylene). Potentiation is characteristically exhibited at high concentrations, less probably at low.

When a given operation or process characteristically emits a number of harmful dusts, fumes, vapors or gases, it will frequently be only feasible to attempt to evaluate the hazard by measurement of a single substance. In such cases, the threshold limit used for this substance should be reduced by a suitable factor, the magnitude of which will depend on the number, toxicity and relative quantity of the other contaminants ordinarily present.

Examples of processes which are typically associated with two or more harmful atmospheric contaminants are welding, automobile repair, blasting, painting, lacquering, certain foundry operations, diesel exhausts, etc. (Example 2 in 1A.a.).

THRESHOLD LIMIT VALUES FOR MIXTURES

EXAMPLES

1A.a. General case, where air is analyzed for each component:

a. Additive effects. (Note: It is essential that the atmosphere be analyzed both qualitatively and quantitatively for each component present, in order to evaluate compliance or non-compliance with this calculated TLV.)

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \frac{C_3}{T_3} + \ldots = 1$$

Example No. 1: Air contains 5 ppm of carbon tetrachloride (TLV = 10 ppm) 20 ppm of ethylene dichloride (TLV = 50 ppm) and 10 ppm of ethylene dibromide (TLV = 25 ppm)

Atmospheric concentration of mixture = 5 + 20 + 10 = 35 ppm of mixture

$$\frac{5}{10} + \frac{20}{50} + \frac{10}{25} = \frac{25 + 20 + 20}{50} = 1.3$$

Threshold Limit is exceeded. Furthermore, the TLV of this mixture may be calculated by reducing the total to 1.0; i.e.

$$\text{TLV of mixture} = \frac{35}{1.3} = 27 \text{ ppm}$$

Example No. 2: Air contains 200 ppm of hexane (TLV = 500 ppm) 100 ppm of methylene chloride (TLV = 500 ppm) and 20 ppm of perchloroethylene (TLV = 100 ppm)

Atmospheric concentration of mixture = 200 + 100 + 20 = 320 ppm of mixture

$$\frac{200}{500} + \frac{100}{500} + \frac{20}{100} = \frac{200 + 100 + 100}{500} = \frac{400}{500} = 0.8$$

Threshold Limit is not exceeded. The TLV of this mixture $= \frac{320}{0.8} = 400$ ppm

1A.b. Special case when the source of contaminant is a liquid mixture and the atmospheric composition is assumed to be similar to that of the original material; e.g. on a time weighted average exposure basis, all of the liquid (solvent mixture) eventually evaporates.

Additive effects (approximate solution)

1. The percent composition (by weight) of the liquid mixture is known, the TLVs of the constituents must be listed in mg/m^3.

NOTE: Though this regulation has been adopted by the Commission, it must still be approved by the State Attorney General's Office prior to official publication.

Adopted: July 25, 1974
Effective:

REGULATION NO. 9

The Control of Automotive Air Pollution through Motor Vehicle Restraints and the Encouragement of Public Transportation and Carpooling

I. AREA OF APPLICATION:

This Regulation No. 9 shall apply to the Metropolitan Denver Air Quality Control Region, which includes the counties of Adams, Arapahoe, Boulder, Denver, Douglas, and Jefferson.

II. PREFERENTIAL TREATMENT OF BUSES:

A. By September 1, 1974 (in cooperation with the Denver Regional Council of Governments, the State Department of Highways and each city and county government within the Metro Denver Air Quality Control Region) the Regional Transportation District (R.T.D.) shall develop and submit to the Commission a feasibility study for demonstrating preferential treatment for buses and carpools within the Metro Denver Air Quality Control Region. By July 1, 1975, R.T.D. shall in the same manner develop and submit to the Commission a regional plan for establishing preferential treatment for buses and carpools within this region. This plan shall include implementation steps, time schedules, and costs for implementing this plan by January 1, 1976.

After the Commission holds a public hearing on and adopts the plan, each party so identified in the plan as responsible for a portion of it shall implement that portion.

In connection with the plan, R.T.D. shall demonstrate to the Division that implementation of the preferential treatment of buses will not increase the potential for additional motor vehicle traffic within the affected area.

B. By October 1, 1974, in cooperation with the Denver Regional Council of Governments, the State Department of Highways, and major local business and employment center Associations, the Regional Transportation District (R.T.D.) shall develop and submit to the Commission a plan for automobile intercept parking facilities and express bus service to employment and business centers. Said plan shall include an implementation time schedule and an evaluation of the effect of plan implementation upon reducing vehicle miles traveled (V.M.T.). After the Commission holds a public hearing and adopts the plan, each party so identified in the plan as responsible for a portion of it shall implement that portion.

C. With respect to the requirements of Sections II.A. and II.B. of this regulation, R.T.D. shall by October 1 of each year submit plan revisions and additions for improving the effectiveness of adopted plans.

III. EMPLOYER PLAN REQUIREMENTS FOR CARPOOLING AND MASS TRANSIT INCENTIVES:

A. By November 1, 1974, the Denver Regional Council of Governments shall submit to the Commission a proposal to establish a uniform carpooling locator service for the Denver metropolitan area.

B. By February 1, 1975, all public and private employers which employ more than two hundred fifty (250) employees at one time in any one plant or other business location shall submit an affidavit, or plan, to the Division on forms provided by the Division. This affidavit shall be signed by an authorized company employee. The affidavit shall state that: 1) The locator service developed as per Section III.A of this regulation will be provided by the employer for use by all interested employees; or that: 2) another carpooling locator service of equal or greater effectiveness will be used. In the case of an alternative locator service, the employer must submit for approval by the Division a plan describing the system and effectiveness of it. The affidavit, or plan, shall provide the following:

1. That the carpooling locator service must be fully implemented by April 1, 1975.

2. That the carpooling locator service shall be for the purpose of matching people to facilitate the transporting of two (2) or more persons per vehicle.

3. A description of employee incentives to encourage the use of carpooling; such as, free or reserved parking adjustments in favor of carpooled vehicles where employee parking is provided, imposition of parking charges on non-carpooled vehicles, or other incentives.

4. A description of measures to encourage employees to use bicycles and public transportation; such as, posting information for employees as to the availability of bicycle lanes and public transportation to and from the place of employment; and providing incentives for use of same (reimbursement of fares for use of public transportation, provision of secure and convenient parking for bicycles, and/or other similar fringe benefits).

C. The Requirements of Section III.B shall apply to all public and private employers which employ more than fifty (50) employees at one time in any one plant or other business location exactly six months later than the time requirements of Section III.B (plan submittal by August 1, 1975 and carpooling locator service implemented by October 1, 1975).

D. All employers regulated by this Section III.D shall, on an annual basis coinciding with the plan submittal date, submit on a form provided by the Division a brief progress report as to the effectiveness of implementing measures as required in this Section III.D.

IV. MOTOR VEHICLE PARKING:

By March 1, 1975, the Denver Regional Council of Governments (in cooperation with the State Department of Highways and Regional Transportation District (R.T.D.) shall provide written advice to the Commission as to the relationship, if any, between restricting the construction of new parking spaces in the Denver area and reducing vehicle miles traveled. It shall also recommend to the Commission parking requirements that may stimulate the use of public transportation and decrease single passenger vehicle miles traveled.

AMBIENT AIR STANDARDS FOR METROPOLITAN DENVER AIR QUALITY CONTROL REGION, AIR QUALITY CONTROL AREAS, AND THE STATE OF COLORADO

Colorado Air Pollution Control Commission

Adopted : September 10, 1970
Effective Date: December 17, 1970

SULFUR DIOXIDE

Areas of the State not included in Air Quality Control Areas

Achieve a Short Term Level of: A 24-hour maximum arithmetic mean of 15 micrograms per cubic meter in any 24-hour period and must not be exceeded more than once in a twelve-month period.

Air Quality Control Areas including the Metropolitan Denver Air Quality Control Region:

On or before January 1, 1973, achieve a One Hour Level of: A 1-hour maximum arithmetic mean of 800 micrograms per cubic meter of air in any 24-hour period, and must not be exceeded more than once in any 1-month period.

On or before January 1, 1973, achieve a Short Term Level of: A 24-hour maximum arithmetic mean of 300 micrograms per cubic meter of air in any 24-hour period and must not be exceeded more than once in a 12-month period.

On or before January 1, 1973, achieve a Long Term Level of: An annual arithmetic mean of all 24-hour concentrations which must not exceed 60 micrograms per cubic meter of air.

On or before January 1, 1976, achieve a One Hour Level of: A 1-hour maximum arithmetic mean of 300 micrograms per cubic meter of air in any 24-hour period, and must not be exceeded more than once in any 1-month period.

On or before January 1, 1976, achieve a Short Term Level of: A 24-hour maximum arithmetic mean of 150 micrograms per cubic meter of air in any 24-hour period and must not be exceeded more than once in a 12-month period.

On or before January 1, 1976, achieve a Long Term Level of: An annual arithmetic mean of all 24-hour concentrations which must not exceed 25 micrograms per cubic meter of air.

On or before January 1, 1980, achieve a Short Term Level of: A 24-hour maximum arithmetic mean of 55 micrograms per cubic meter of air in any 24- hour period and must not be exceeded more than once in a 12-month period.

On or before January 1, 1980, achieve a Long Term Level of: An annual arithmetic mean of all 24-hour concentrations which must rot exceed 10 micrograms per cubic meter of air.

Method of Testing

The method used to measure sulfur dioxide is the West-Gaeke method. Other methods may be used if they have been demonstrated to be equally or more specific, sensitive, and reproducible. Results are expressed as micrograms of sulfur dioxide per cubic meter of ambient air. These values may be converted to parts per million by volume by dividing by 2860. (1 ppm = 2860 ug/m_3 at 0°C and 760mm Hg (Torr.)).

ppm = parts per million
ug/m^3 = micrograms per cubic meter of air

AMBIENT AIR STANDARDS FOR
METROPOLITAN DENVER AIR QUALITY CONTROL REGION,
AIR QUALITY CONTROL AREAS, AND
THE STATE OF COLORADO

ADOPTED : September 10, 1970
EFFECTIVE: December 17, 1970

SUSPENDED PARTICULATE MATTER:

Areas of the State not included in Air Quality Control Areas

Achieve a Short Term Level of: A 24-hour maximum of 150 micrograms per cubic meter of air in any 24-hour period and must not be exceeded more than once in a twelve-month period.

Achieve a Long Term Level of: An annual arithmetic mean of all 24-hour concentrations which must not exceed 45 micrograms per cubic meter of air.

Air Quality Control Areas including the Metropolitan Denver Air Quality Control Region:

On or before January 1, 1973, achieve a Short Term Level of: A 24-hour maximum of 200 micrograms per cubic meter of air in any 24-hour period and must not be exceeded more than once in a twelve-month period.

On or before January 1, 1973, achieve a Long Term Level of: An annual arithmetic mean of all 24-hour concentrations which must not exceed 70 micrograms per cubic meter of air.

On or before January 1, 1976, achieve a Short Term Level of: A 24-hour maximum of 180 micrograms per cubic meter of air in any 24-hour period and must not be exceeded more than once in a twelve-month period.

On or before January 1, 1976, achieve a Long Term Level of: An annual arithmetic mean of all 24-hour concentrations which must not exceed 55 micrograms per cubic meter of air.

On or before January 1, 1980, achieve a Short Term Level of: A 24-hour maximum of 150 micrograms per cubic meter of air in any 24-hour period and must not be exceeded more than once in a twelve-month period.

On or before January 1, 1980, achieve a Long Term Level of: An annual arithmetic mean of all 24-hour concentrations which must not exceed 45 micrograms per cubic meter of air.

Method of Testing

Suspended particulate matter is measured gravimetrically using the high-volume sampler technique described by the National Air Pollution Control Administration. Suspended particulate numerical levels are expressed in micrograms per cubic meter of ambient air sampled.

TABLE I

AMBIENT AIR STANDARDS FOR METROPOLITAN DENVER AIR QUALITY CONTROL REGION, AIR QUALITY CONTROL AREAS, AND THE STATE OF COLORADO

SUSPENDED PARTICULATE MATTER AND SULFUR DIOXIDE

(Micrograms per cubic meter - ug/m^3)

Pollutant	Non Designated Areas	Metro-Denver Air Quality Control Region, and Designated State Areas		
		1973	1976	1980
Suspended Particulate Matter[a] Short Term[c(i)]	150	200	180	150
Long Term[d]	45	70	55	45
Sulfur Dioxide[b] One hour Level[e]		800 (0.28)[f]	300 (0.10)[f]	
Short Term[c(ii)]	15 (0.0050)[f]	300 (0.10)[f]	150 (0.050)[f]	55 (0.020)[f]
Long Term[d]		60 (0.020)[f]	25 (0.0090)[f]	10 (0.0040)[f]

a. Measured at ambient conditions.

b. 0° Centigrada - 760 mm Hg (Torr.)

c. Short Term Level
   (i) A 24-hour maximum of any 24-hour period and must not be exceeded more than once in a 12-month period.
   (ii) A 24-hour maximum arithmetic mean of any 24-hour period, and must not be exceeded more than once in a 12-month period.

d. Long Term Level - An annual arithmetic mean of all 24-hour concentrations.

e. One hour Level - A 1-hour maximum arithmetic mean in any 24-hour period, and must not be exceeded more than once in any 1-month period.

f. ( ) = Equivalent values in parts per million (1 ppm = 2860 ug/m^3 at 0°C and 760 mm Hg (Torr)).

Statements of Policy by the Commission

Colorado Air Pollution Control Commission

STATEMENT OF POLICY
to
PART IV.A
COMMON PROVISIONS APPLICABLE TO BOTH AUTHORITY TO CONSTRUCT AND PERMIT TO OPERATE

The Commission directs that the Division or Commission staff may still require persons exempted by Part IV.A of Regulation No. 3 to supply any necessary information to the State for the completion of emission inventories as may be required for planning purposes.

Adopted June 8, 1972
Colorado Air Pollution Control Commission

STATEMENT OF POLICY
ON
AGRICULTURAL OPEN BURNING

The following is hereby declared to be the present policy of the Colorado Air Pollution Control Commission regarding Agricultural Open Burning and related matters:

1. A primary current need of the Commission is for the accumulation of information and data regarding agricultural burning and emissions.

2. A voluntary reporting system appears to be of greater usefulness to the Commission in this regard than the use of a permit system application form.

3. The implementation of the proposed agricultural burning permit system under Regulation No. 1 shall be delayed until the effectiveness of an agricultural open burning inventory system is evaluated; and subject to further public hearing.

4. The report and recommendations dated November 10, 1972 of the Agricultural Advisory Committee is adopted, and the Division is directed to implement an Agricultural Open Burning inventory, substantially by use of the Inventory Form attached to the Advisory Committee's report.

5. The Agricultural Advisory Committee has functions for the mutual benefit of the Air Pollution Control Commission and the agricultural community. It shall be kept operational through 1974 as requested in its report of November 10, 1972.

6. The permit system provisions of Regulation No. 1 regarding agricultural open burning shall continue to be the basis (in the sense of enabling authority) for local enforcement (including permit systems) regarding agricultural burning. The adoption of this Policy Statement by the Commission shall not be deemed to restrict or affect independent local enforcement in this area.

7. The Commission's endorsement of the voluntary, rather than mandatory, compliance feature of the Agricultural Open Burning Inventory concept is based in part, upon the apparent lack of severity of the contribution of agricultural open burning to the air pollution problems of the State as a whole; is limited to the facts and circumstances of agricultural open burning; and does not reflect a general policy of the Commission as to mandatory vs voluntary compliance by individuals with the Commission's air pollution controls.

Adopted November 10, 1972
Colorado Air Pollution Control Commission

SECOND
AMENDED POLICY FOR
ACHIEVING AMBIENT AIR QUALITY STANDARDS ON SCHEDULE

WHEREAS compliance schedules submitted by owners or operators of air contamination sources may be adequate to achieve the emission control regulations of the Commission, but not be adequate to achieve Federal Primary and Colorado State Ambient Air Quality Standards; and

WHEREAS the Commission has adopted (and so has the U.S. Environmental Protection Agency) an Air Quality Control Implementation Plan for the State of Colorado that is designed to achieve Federal Ambient Air Quality Standards for particulate matter and sulfur oxides by 1975;

THEREFORE, the Commission directs the Variance Board not to approve compliance schedules for sources requesting variance unless the Division does predict that the source, when controlled, will not result in exceeding the Federal Primary and Colorado State Ambient Air Quality Standards, and that the compliance shcedule will not prevent meeting ambient air quality standards on schedule.

ALSO, the Commission directs the Division of Air Pollution Control to supply information to the Variance Board, upon request, to enable the Variance Board to determine if compliance schedules are adequate to achieve said ambient air quality standards on schedule.

Lane W Kirkpatrick

Lane W. Kirkpatrick
Technical Secretary
Air Pollution Control Commission

James P Lodge, Jr.

James P. Lodge, Jr., Ph.D.
Chairman
Air Pollution Control Commission

Amended January 5, 1973
2d Amendment, April 26, 1973
Colorado Air Pollution Control Commission

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ADOPTED POLICY
AIR POLLUTION IMPACT - COMPLEX SOURCES

Colorado Air Pollution Control Commission

As a matter of policy, the Commission resolves:

1. That there be a postponement of the approval of the construction of new freeways in the Denver area (and the enlargement of existing freeways) until it has been demonstrated in environmental impact statements for such freeways that such freeways will not adversely affect air quality (both on a short and long term basis).

2. That any new construction of freeways and other "complex air pollution sources"* in the Denver metropolitan area and in other Colorado areas be allowed only when construction of said sources is not likely to endanger the achievement or maintenance of ambient air quality standards.

3. In order to meet Federal ambient air quality standards on schedule, the Commission estimates that a significant decrease of projected vehicle miles traveled will be necessary in the Denver area. The Commission feels that automobile traffic should be discouraged while at the same time less polluting alternate forms of transportation should be encouraged.

4. That the Colorado Legislature recognize the importance of and pass legislation mandating the joint use of Land Use and Transportation planning as necessary tools for the attainment and maintenance of publicly acceptable levels of air quality by granting sufficient powers to appropriate agencies for this purpose.

Lane Kirkpatrick
Technical Secretary
Air Pollution Control Commission

James P. Lodge, Jr., Ph.D.
Chairman
Air Pollution Control Commission

*Complex Air Pollution Source (Indirect Source)- means facilities or activities, which perhaps though non-polluting in themselves, generate air pollution as a result of adjunct or secondary activities; for example, by the generation of motor vehicle traffic.

Adopted April 26, 1973
Air Pollution Control Commission
State of Colorado

COMMON PROVISIONS REGULATION

Definitions, Statement of Intent and General Provisions applicable to all emission control regulations adopted by the Colorado Air Pollution Control Commission

Colorado Air Pollution Control Commission

Adopted : December 9, 1971
Effective Date: February 1, 1972

PROPOSED REGULATIONS

NOTICE OF PUBLIC HEARINGS
before the
COLORADO AIR POLLUTION CONTROL COMMISSION

Pursuant to the provisions of Section 3-16-2 C.R.S. 1963 as amended (1967-1969 Perm.Cum.Supps.) and 66-31-9 as amended (1971 Perm.Cum.Supps.) pursuant to which public hearing procedures are herein and will be following, and of 66-31-6, 66-31-7, 66-31-8 and 66-31-9, as amended, (1971 Perm.Cum. Supps.) of the "Air Pollution Control Act of 1970", C.R.S. 1963, as amended, which sections prescribe the legal authority for the Commission to adopt such regulations or amendments, NOTICE is hereby given that the Colorado Air Pollution Control Commission, after due and proper notice given pursuant to said Section 66-31-9, will conduct a public hearing in accordance with the provisions of Section 3-16-4, C.R.S. 1963, as amended (1969 Perm.Cum.Supps.), to be held:

JUNE 24, 1974 (Monday) 9:30 a.m. to 5 p.m.	BOULDER, COLORADO National Center for Atmospheric Research Main Seminar Room 1850 Table Mesa Drive
JUNE 25, 1974 (Tuesday) 9:30 a.m. to 5 p.m.	COLORADO SPRINGS, COLORADO Colorado Springs Auditorium Little Theatre Kiowa and Weber Streets (Use Weber Street Entrance)
JUNE 27, 1974 (Thursday) 9:30 a.m. to 5 p.m.	GLENWOOD SPRINGS, COLORADO County Court House (District Court) Corner of Colorado & 8th Avenue

for the purpose of considering and promulgating the following proposals to amend the Colorado Air Pollution Control Commission's "Air Quality Control Regulations and Ambient Air Quality Standards" in particular amending the following regulations, copies of which are hereto as proposed:

Amend by Adding to:	COMMON PROVISIONS REGULATION - (pp. 1 and 2)	
	Section III.	"Smoking Gasoline-Powered Motor Vehicle Control Region." A description and map designating the Denver Air Quality Control Region as a "Smoking Gasoline-Powered Motor Vehicle Control Region" pursuant to Section 40-13-110(1)(a)(ii), Colorado Revised Statutes, 1963, as amended. (Counties of: Denver, Adams, Jefferson, Arapahoe, Douglas, Gilpin, Clear Creek and Boulder)

Repeal and Reenact

REGULATION NO. 3 - (pp. 3 - 34)

- I. Air Contaminant Emission Notice
- II. Permits for Direct Air Contaminant Sources
- III. Permits for Indirect Air Contaminant Sources
- IV. Portable Emission Sources

Note:
(Since a revised Regulation No. 3 had a public hearing January 8, 1974 which applied to the Denver Air Quality Control Region only, the attached Regulation No. 3, Section III dealing with Indirect Air Contaminant Emission Sources excludes the Denver Region but applies to the rest of the State).

Amend

REGULATION NO. 7 - (pp. 35 - 46)

Sections:
- A. Affected State Areas
- B. Petroleum Distillate Storage at Pipeline Termination and Refineries
- C. Petroleum Distillate Transfer
- G. Organic Solvents
- J. Drycleaning Solvents
- L. Effective Date

The Commission will receive oral or written data, evidence, and testimony and afford interested persons an opportunity to submit views and arguments and otherwise to participate informally in conferences on the proposals under consideration with regard to all of the rules, regulations, amendments, and reenactments and additions proposed for its consideration leading to the ultimate action by the Commission. Any interested person shall have an opportunity to participate at said hearings in person or through counsel.

Any person desiring to propose rules, regulations, or amendments in lieu of those proposed by the Commission may file such other proposal with Mr. Lane Kirkpatrick, Technical Secretary to the Commission on or before 5 p.m., June 4, 1974, and when so filed, shall be open for public inspection in Room 319 at the Colorado Department of Health, 4210 East 11th Avenue, Denver, Colorado 80220.

Witnesses at the hearing shall be subject to cross-examination by the Commission, or by or on behalf of persons who have submitted proprosals pursuant to the preceding paragraph.

Should all testimony be given to the Commission prior to 5 p.m. on the date of the hearing, the Commission will close the hearing at such time, but may hold the record open for further written amendment from those in attendance or represented at said hearing which amended proposals shall be made available to those requesting copies thereof, for consideration at the next succeeding Commission meeting.

The effective date of such amendments and additions to rules and regulations as may be adopted by the Commission will be determined following receipt of the Attorney General's opinion as to the legality and constitutionality thereof and shall not be less than thirty (30) days after the same shall have been published and filed in the Office of the Secretary of State of Colorado.

There shall be made available to the public and delivered to anyone requesting the same, a copy of any rule of the Commission now in effect, if not otherwise contained among the attached material, or of any notice of proposed rule-making proceeding in which action has not been completed which, upon request, shall be certified. The Commission may make a reasonable charge for supplying such material.

COLORADO AIR POLLUTION CONTROL COMMISSION

James P Lodge Jr

James P. Lodge, Jr., Ph.D., Chairman

DATED:

Attachments

Legal List on File with Legal Counsel
Colorado Department of Health

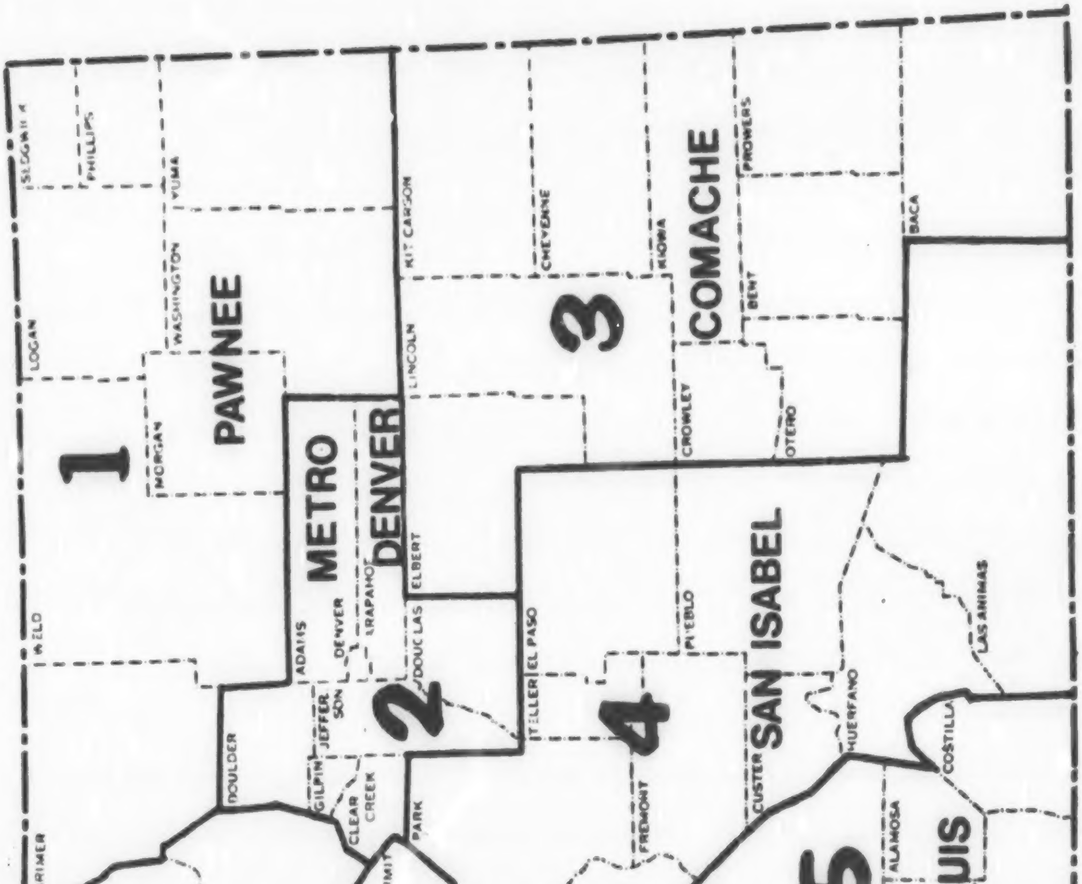
PROPOSED AMENDMENT TO
COMMON PROVISIONS REGULATION

PROPOSED SMOKING VEHICLE AREA DESIGNATION

III.

PURSUANT TO SECTION 40-13-110(1)(a)(ii), C.R.S. 1963 AS AMENDED (1.73, § 5, pp. 745,746) THE AIR POLLUTION CONTROL COMMISSION HEREBY DESIGNATES THE FEDERAL AIR QUALITY CONTROL REGION WHICH INCLUDES THE COUNTIES OF ADAMS, ARAPAHOE, BOULDER, CLEAR CREEK, DENVER, DOUGLAS, GILPIN AND JEFFERSON AS A "SMOKING GASOLINE-POWERED MOTOR VEHICLE CONTROL REGION." THIS DESIGNATION WILL ENABLE THE ENFORCEMENT OF SAID SECTION BY PEACE OFFICERS TRAINED BY THE COMMISSION IN OPACITY DETERMINATION. THIS REGION IS THE SAME REGION TO WHICH PORTIONS OF THE COLORADO STATE IMPLEMENTATION PLAN APPLIES.

THE COMMISSION UPON REVIEW OF AMBIENT AIR QUALITY DATA HAS DETERMINED THAT ON AT LEAST THIRTY-ONE (31) OCCASIONS, CARBON MONOXIDE LEVELS EXCEEDED NINE (9) PARTS PER MILLION (ppm) AVERAGED OVER EIGHT (8)-HOUR NON-OVERLAPPING PERIODS. THEREFORE THE COMMISSION FEELS REGIONAL DESIGNATION IS WARRANTED UNDER THE PROVISIONS OF THIS SECTION.


1
PAWNEE
2
METRO DENVER
3
COMACHE
4
SAN ISABEL
5
SAN LUIS
6
FOUR CORNERS
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GRAND MESA
8
YAMPA
SEDGWICK
PHILLIPS
LOGAN
YUMA
WASHINGTON
MORGAN
WELD
ADAMS
DENVER
ARAPAHOE
JEFFERSON
DOUGLAS
ELBERT
KIT CARSON
LINCOLN
CHEYENNE
KIOWA
PROWERS
BENT
CROWLEY
OTERO
BACA
LAS ANIMAS
PUEBLO
EL PASO
TELLER
FREMONT
CUSTER
HUERFANO
COSTILLA
ALAMOSA
RIO GRANDE
CONEJOS
SAGUACHE
MINERAL
HINSDALE
ARCHULETA
SAN JUAN
LA PLATA
MONTEZUMA
DOLORES
SAN MIGUEL
OURAY
MONTROSE
DELTA
GUNNISON
PITKIN
MESA
GARFIELD
EAGLE
SUMMIT
LAKE
CHAFFEE
PARK
CLEAR CREEK
GILPIN
BOULDER
LARIMER
GRAND
JACKSON
ROUTT
MOFFAT
RIO BLANCO

Colorado Air Quality Control Regions

DRAFT
March 28, 1974

Proposed for Public Hearing

REPEAL AND REENACTMENT OF

REGULATION NO. 3

Regulation Governing Authority to Construct and Permit to Operate

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REVISED

REGULATION NO. 3

Regulation Governing Authority to Construct and Permit to Operate

I. INSTRUCTIONS, PROCEDURAL GUIDELINES, AND SAMPLE FORMS FOR FILING AN AIR CONTAMINANT EMISSION NOTICE: (REQUIRED AS PART OF THE IMPACT STATEMENT FOR DIRECT AIR CONTAMINATION SOURCES).

The Act requires an "air contaminant emission notice" be filed with the Department prior to the emission of an air contaminant from any facility, process, or activity. The Commission has defined insignificant sources exempted from filing a notice as listed in ARTICLE II.C.2 of Regulation No. 3. Any facility, process, or activity which is altered, RESULTING in A CHANGE in emission of air contaminants, must also file an "air contaminant emission notice" with the Department with respect to such proposed emission. A revised emission notice is required and shall be filed whenever a significant change in emissions shall have occurred. (See instructions)

Effective July 10, 1970, no person shall discharge, or cause to be discharged, into the atmosphere any air contaminant if an "air contaminart emission notice" has not been filed. Failure to comply with this provision of the Act is punishable by a fine of not more than one hundred dollars ($100).

The Air Contaminant Emission Notice may be obtained from the Colorado Department of Health (see below) or from any local air pollution control agency in Colorado.

The Air Contaminant Emission Notice is to be completed in triplicate and all copies mailed to:

COLORADO DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL DIVISION
4210 East 11th Avenue
Denver, Colorado 80220

AIR CONTAMINANT EMISSION NOTICE

INSTRUCTIONS

This form shall include information relating to a single stack or vent. The process, fuel, and control information included shall relate to the emissions from this stack. Separate forms shall be filed for each stack or source of emissions.

A. General Information:

Record the city and county where the equipment is located, number of employees, land area, operating time, and percent throughput.

B. Stack Information:

This information must be completed by the applicant. The stack height shall be the measured height from ground level to the top of the stack or vent. Flow rate shall be given in actual cubic feet per minute at stack exit temperature and pressure.

C. Fuel Information:

Type of Unit:	This shall be the equipment that burns the fuel. Example: oil burner, coal burner, gas burner, or any other unit that utilizes fuel or involves combustion.
Design Rate:	Capacity of each fuel burning equipment (BTU/hr.).
Fuel Used:	Name the fuel used and print in the space, in line with the equipment that uses the fuel.
Consumption:	Print the amount of fuel used per year in units like tons/year, gallons/year, 10^6 SCF/year.
Heating Value:	This shall be given in BTU/unit of fuel.
Percent Annual Use:	This information shall be given for each fuel used separately, to total 100% per year.

D. Process Information:

Process Equipment:	List the major process equipment that causes or contributes to the emissions from this stack or vent.
Raw Materials, etc.	List all materials used during each process.
Units/year:	List amount of these materials used in proper units/year.
Design Rate:	This shall be the design rate of usage of raw materials of the process equipment and shall be given in proper units per hour.
Finished Products:	Name the finished products from these processes and print the units/year.

E. Control Equipment:

Primary and Secondary Controls:	All air pollution control equipment used on the emissions released by this particular stack or vent shall be reported. When two or more controls are used, the first type of control equipment in line will be the primary collector, and the others will be secondary controls.
Collection Efficiency:	This shall include the total efficiency of all the above control equipment.
Estimated Emissions:	This figure shall be estimated at the exit end of the stack or vent in tons/year.
Method of Estimation:	(e.g., source test, emission factors, experience with similar sources, or guesswork)

This submittal should include a simple block figure flow diagram showing all process equipment, flow of materials, and all emission points with emission estimates. Include manufacturers' brochures, if available.

Mail this information to:

Air Pollution Control Division
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220

APC-200A (11-72-20)

Colorado Department of Health

Notice No.__________

AIR CONTAMINANT EMISSIONS NOTICE

Date__________

Original ☐
Follow Up ☐
Complaint ☐
Inventory ☐
New Plant ☐
Ex. Plant ☐
Alteration ☐

Firm Name____
Mail Address____ Zip________
Plant Address_______________________________________ Zip________
Contact Person____________________ Title_________________ Tel________
General Nature of Business____

This line for Health Dept use only						UTM Coordinates	
AQCR	Grid No.	Plant ID	Point ID	SIC	IPP Process	Horizontal	Vertica

A. GENERAL

City	County	No. Employees	Land Area	Normal Operation			% Annual Thru Put			
				Hr./Day	Day/Wk.	Wk./Yr.	Win.	Spr.	Sum.	Fall

B. STACK OR VENT INFORMATION

Height (ft)	Exit Diameter (ft)	Temperature °F	Flow Rate (ACFM)	Moisture Content

C. FUEL INFORMATION

Type of Unit	Design Rate BTU/hr.	Fuel Used	Consumption Units/ Yr.	Heating Value	% Sulfur	% Annual Use				Space Heat
						Win.	Spr.	Sum.	Fall	

D. PROCESS INFORMATION

Process Equipment Description	Raw Materials, Solvents, Cleaning Agents, Waste	Units Per Year	Design Rate Units/Hr.	Finished Produc s Units/Yr.

E. CONTROL EQUIPMENT

Pollutants	Type of Control Equipment		Collection Efficiency	Est. Emissions Tons/Yr.	Method of Estimation	Installation Date	Cost
	Primary	Secondary					
Particulate							
SC							
NO_x							
HC							
CO							
Other (specify)							

Signature of Person
Supplying Data________________________

COLORADO DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL DIVISION
4210 E. 11th Ave.
Denver, Colorado 80220
1-303-388-6111 ext. 241

APC-200A-20

II. DIRECT AIR CONTAMINATION SOURCES

A. GENERAL -

No person shall construct or modify any new DIRECT air contamination source mentioned in Paragraph C without receiving written authorization from the Division. SOURCES WHICH MEET THE DEFINITION OF BOTH DIRECT AND INDIRECT AIR CONTAMINATION SOURCES SHALL BE SUBJECT TO DUAL CONTROLS AND PERMIT REQUIREMENTS UNDER THIS REGULATION.

B. APPLICATION AND EFFECTIVE DATE -

THIS ARTICLE II SHALL APPLY STATEWIDE AND SHALL BECOME EFFECTIVE THIRTY (30) DAYS AFTER ADOPTION.

C. DEFINITIONS AND EXCEPTIONS -

1. THE TERM "DIRECT AIR CONTAMINATION SOURCE" SHALL INCLUDE THE FOLLOWING:

   Classes of machines, equipment, articles, FACILITIES, STRUCTURES and contrivances.

   a. Basic equipment -

      This class includes any machine, equipment, article or other contrivance associated with operations except as exempted in Paragraph C.2, the use of which may cause the emission of air contaminants.

   b. Air pollution control equipment -

      This class includes any machine, equipment, article or other contrivance associated with operations or processes except as exempted in Paragraph C.2, the use of which may eliminate or reduce or control the emission of air contaminants.

2. THE FOLLOWING DIRECT AIR CONTAMINATION SOURCES ARE EXEMPT FROM THE REQUIREMENTS OF THIS ARTICLE II:

a. Structures used solely as residential dwellings and which do not exceed seven family units;

b. EXISTING, AS OF EFFECTIVE DATE OF THIS REGULATION, retail and wholesale establishments where no processing or incineration occurs and where solid or liquid fuel is not burned;

c. Air conditioning or ventilating systems not designed to remove air contaminants generated by or released from equipment;

d. Fuel-burning equipment, other than smokehouse generators, which use gas as a fuel having a BTU input of not more than 500,000 BTU per hour;

e. Fireplaces used for inside or outside recreational purposes;

f. Fires used for non-commercial cooking of food for human beings;

g. The installation or alteration of an air contaminant detector, or air contaminant recorder;

h. Laboratory equipment used exclusively for chemical or physical analyses;

i. Flares used to indicate some danger to the public;

j. Normal agricultural cultivation operations;

k. Internal combustion engines are exempt except that emission notices and permit to operate are required for engines of greater than 1,000 horsepower.

l. Natural gas-fired indirect heat exchangers used as separators and known as heater treaters when used in oil and gas field operations when sweet gas is burned.

3. THE FOLLOWING ADMINISTRATIVE PROCEDURES AND STATEMENTS CONSTITUTE THE MECHANICS OF THE PERMIT SYSTEM UNDER THIS ARTICLE:

a. PREPLANNING REVIEW

b. AUTHORITY TO CONSTRUCT

c. IMPACT STATEMENT

4. THE PHRASE "TO COMMENCE CONSTRUCTION" MEANS TO ENGAGE IN A CONTINUOUS PROGRAM OF CONSTRUCTION INCLUDING SITE CLEARANCE, GRADING, DREDGING, OR LAND FILLING SPECIFICALLY DESIGNED FOR A DIRECT SOURCE IN PREPARATION FOR THE FABRICATION, ERECTION, OR INSTALLATION OF THE BUILDING COMPONENTS OF THE DIRECT SOURCE. INTERRUPTIONS RESULTING FROM ACTS OF GOD, STRIKES, LITIGATION, OR OTHER MATTERS BEYOND THE CONTROL OF THE OWNER SHALL BE DISREGARDED IN DETERMINING WHETHER A CONSTRUCTION OR MODIFICATION PROGRAM IS CONTINUOUS.

5. THE PHRASE "TO COMMENCE MODIFICATIONS" MEANS TO ENGAGE IN A CONTINUOUS PROGRAM OF MODIFICATION, INCLUDING SITE CLEARANCE, GRADING, DREDGING, OR LAND FILLING IN PREPARATION FOR A SPECIFIC MODIFICATION OF THE DIRECT SOURCE.

D. PREPLANNING REVIEW -

1. GENERAL REQUIREMENT:

a. PRIOR TO SUBMITTING AN APPLICATION FOR AUTHORITY TO CONSTRUCT, THE APPLICANT SHALL MAKE A REQUEST TO THE DIVISION FOR A PREPLANNING REVIEW.

b. THIS PREPLANNING REVIEW, AT THE DISCRETION OF THE DIVISION, MAY BE A TELEPHONE DISCUSSION, A MEETING, A SITE INSPECTION, OR COMBINATION THEREOF, FOR THE PURPOSE OF EXCHANGING CONTROL REQUIREMENT INFORMATION, AIR MONITORING AND AIR POLLUTION PREDICTIVE MODELING REQUIREMENTS, AND DISCUSSING OTHER REQUIREMENTS AS OUTLINED IN PARAGRAPH E (AUTHORITY TO CONSTRUCT) AND PARAGRAPH F (IMPACT STATEMENT). SUCH REVIEW IS ADVISABLE PRIOR TO LARGE SCALE PLANNING AND DESIGN EXPENDITURES ON BEHALF OF THE APPLICANT TO DISCUSS WITH THE DIVISION IN CONCEPTUAL TERMS THE NATURE AND SCOPE OF THE PROPOSED PROJECT AS RELATING TO AIR POLLUTION CONTROL REQUIREMENTS. THE DIVISION SHALL ADVISE THE APPLICANT IN WRITING THAT ITS CONCLUSIONS ARE ADVISORY IN NATURE TO THE APPLICANT FOR ASSISTING IN THE REVIEW OF DETAILED FORMAL APPLICATION FOR AUTHORITY TO CONSTRUCT.

c. AT THE PREPLANNING CONFERENCE, THE APPLICANT SHALL DISCUSS WITH THE DIVISION THE AVAILABILITY AND NEED FOR DATA ON PRESENT AIR QUALITY, TOPOGRAPHY, METEOROLOGY AND EMISSIONS FROM OTHER SOURCES IN THE AFFECTED AREA. SUCH DATA WHICH THE DIVISION HAS OBTAINED FROM EMISSION INVENTORIES, PREVIOUS SAMPLING PROGRAMS OR OTHER MEANS

SHALL BE MADE AVAILABLE TO THE APPLICANT IN CONJUNCTION WITH THE PREPLANNING REVIEW AS AN AID TO THE APPLICANT IN PREPARING THE IMPACT STATEMENT.

d. THE DIVISION MAY REQUIRE AMBIENT AIR MONITORING FOR A PERIOD OF NOT MORE THAN TWELVE (12) MONTHS BY APPLICANT PRIOR TO FILING OF APPLICATION FOR AUTHORITY TO CONSTRUCT BUT SHALL SPECIFY THE MINIMUM PERIOD AND TIME OF YEAR FOR AIR MONITORING SUFFICIENT TO ESTIMATE BACKGROUND LEVELS OF MAJOR AIR POLLUTANTS.

E. AUTHORITY TO CONSTRUCT -

1. GENERAL REQUIREMENT:

a. NO PERSON SHALL CONSTRUCT OR MODIFY A DIRECT AIR CONTAMINANT EMISSION SOURCE WITHOUT FILING AN APPLICATION FOR AUTHORITY TO CONSTRUCT AND RECEIVING WRITTEN AUTHORIZATION FROM THE DIVISION EXCEPT AS EXEMPTED PER PARAGRAPH C.2.

b. TOGETHER WITH THE APPLICATION, THE APPLICANT SHALL SUBMIT A DETAILED STATEMENT OF AIR POLLUTION IMPACT (IMPACT STATEMENT) OF THE PROPOSED ACTION AS DESCRIBED IN PARAGRAPH F.

c. APPLICATIONS SHALL BE SIGNED BY THE INDIVIDUAL LEGALLY RESPONSIBLE AND AUTHORIZED TO DO SO, AND HE THEREBY COVENANTS THAT THE APPLICANT WILL EITHER CONSTRUCT OR MODIFY THE AIR CONTAMINATION SOURCE IN ACCORDANCE WITH THE REQUIREMENTS FOR GRANTING APPLICATIONS AS OUTLINED IN THIS REGULATION.

2. STANDARDS FOR GRANTING OR DENYING APPLICATIONS:

a. NO AUTHORITY TO CONSTRUCT SHALL BE GRANTED TO THE APPLICANT UNLESS THE DIVISION DETERMINES TO ITS SATISFACTION THAT:

a-1. THE NEW DIRECT AIR CONTAMINATION EMISSION SOURCE IS DESIGNED, BUILT, AND EQUIPPED IN ACCORDANCE WITH THE BEST AVAILABLE TECHNOLOGY AND OTHER ALTERNATIVES TO REDUCE, PREVENT, AND CONTROL AIR POLLUTION.

a-2. THE NEW DIRECT AIR CONTAMINATION EMISSION SOURCE IS SO DESIGNED AND WILL BE CONSTRUCTED OR MODIFIED TO OPERATE WITHOUT CAUSING A VIOLATION OF THE EMISSION CONTROL REGULATIONS OF THE COMMISSION, AND ANY APPLICABLE NATIONAL OR LOCAL AIR POLLUTION EMISSION CONTROL ORDINANCES AND REGULATIONS.

a-3. THE AIR CONTAMINATION EMISSION SOURCE, AS DESIGNED OR MODIFIED, DOES NOT SIGNIFICANTLY ENDANGER MAINTTENANCE OR ATTAINMENT OF ANY AMBIENT AIR QUALITY STANDARDS OF THE COMMISSION, AND ANY MORE STRINGENT NATIONAL OR LOCAL AMBIENT AIR QUALITY STANDARDS.

a-4. THE APPLICATION SHALL CONTAIN ACCEPTABLE HALT OR CURTAILMENT PROCEDURES WHICH CONFORM WITH THE REQUIREMENTS OF SECTION 66-31-11 OF THE ACT. SUCH PROCEDURES SHALL STATE THE TIMES IN WHICH THE APPLICANT SHALL HALT OR CURTAIL ACTIVITIES UPON BEING NOTIFIED OF THE DECLARATION OF AN AIR POLLUTION EMERGENCY.

a-5. IF THE CONDITIONS OF a-2 AND a-3 OF THIS SUBSECTION CANNOT BE MET, YET THE APPLICANT UTILIZES THE BEST AVAILABLE TECHNOLOGY AND OTHER ALTERNATIVES, WHICH WOULD SIGNIFICANTLY REDUCE OR MINIMIZE POLLUTION, THE DIVISION SHALL CONSULT WITH THE COMMISSION AND THEREAFTER THE DIVISION, WITH THE CONCURRENCE OF THE COMMISSION OR THE COMMISSION ALONE, MAY GRANT THE PERMIT.

b. CONDITIONAL APPROVAL OF APPLICATIONS;

b-1. AN AUTHORITY TO CONSTRUCT OR MODIFY MAY BE ISSUED TO AN APPLICANT OWNING OR OPERATING ANY AIR CONTAMINANT EMISSION SOURCE SUBJECT TO CONDITIONS WHICH WILL MAKE THE EQUIPMENT OR FACILITY OPERATE WITHIN THE EMISSION CONTROL REGULATIONS AND AMBIENT AIR QUALITY STANDARDS OF THE COMMISSION OR APPLICABLE NATIONAL OR LOCAL'AIR POLLUTION CONTROL ORDINANCES AND REGULATIONS, AND AMBIENT AIR QUALITY STANDARDS, IN WHICH CASE THE CONDITIONS WILL BE SPECIFIED IN WRITING. COMMENCING WORK UNDER SUCH AN AUTHORITY TO CONSTRUCT SHALL BE DEEMED ACCEPTANCE BY THE APPLICANT OF ALL CONDITIONS SPECIFIED.

b-2. THE DIVISION MAY IMPOSE CONDITIONS UPON THE APPLICANT IN THE AUTHORITY TO CONSTRUCT OR MODIFY WHICH REQUIRE OWNERS OR OPERATORS OF AIR CONTAMINATION EMISSION SOURCES TO INSTALL, MAINTAIN, AND USE INSTRUMENTATION TO MONITOR AND RECORD EMISSION AND AMBIENT AIR DATA AS A BASIS FOR PERIODIC REPORTS TO THE DIVISION.

c. DENIAL OF AN APPLICATION:

c-1. IN THE EVENT OF A DENIAL OF AN APPLICATION THE DIVISION SHALL NOT ACCEPT A FURTHER APPLICATION UNLESS THE APPLICANT HAS COMPLIED WITH THE OBJECTIONS SPECIFIED AS REASONS FOR DENIAL.

c-2 PRIOR TO THE APPLICANT BEING NOTIFIED, IN WRITING, OF DENIAL, A CONFERENCE BETWEEN THE DIVISION AND THE APPLICANT MAY BE HELD TO DISCUSS THE REASONS FOR DENIAL.

3. REQUIREMENTS FOR REVIEWING APPLICATIONS:

a. THE DIVISION SHALL PREPARE ITS PRELIMINARY ANALYSIS OF THE EFFECT UPON THE AMBIENT AIR QUALITY AND THE EXTENT OF EMISSION CONTROL WITHIN TWENTY (20) DAYS AFTER DATE ON WHICH AN APPLICATION IS FILED (66-31-12(4)(c).

b. FOR THOSE TYPES OF PROJECTS OR ACTIVITIES DEFINED OR DESIGNATED BY THE COMMISSION AS WARRANTING PUBLIC COMMENT WITH RESPECT THERETO, AS STATED IN PARAGRAPH b-1 OF THIS SUBSECTION (b), THE DIVISION SHALL, WITHIN FIFTEEN (15) DAYS AFTER IT HAS PREPARED ITS PRELIMINARY ANALYSIS, GIVE PUBLIC NOTICE OF THE PROPOSED PROJECT OR ACTIVITY BY AT LEAST ONE PUBLICATION IN THE NEWSPAPER OF GENERAL CIRCULATION IN THE COUNTY IN WHICH THE PROPOSED PROJECT OR ACTIVITY, OR A PART THEREOF, IS TO BE LOCATED. IF NO QUALIFIED NEWSPAPER IS PUBLISHED WITHIN SUCH COUNTY, THEN THE PUBLICATION SHALL BE MADE IN A NEWSPAPER PUBLISHED IN AN ADJOINING OR NEARBY COUNTY. THE DIVISION SHALL ALSO WITHIN SUCH PERIOD OF TIME MAINTAIN IN THE OFFICE OF THE COUNTY CLERK AND RECORDER OF THE COUNTY IN WHICH THE PROPOSED PROJECT OR ACTIVITY, OR A PART THEREOF, IS LOCATED

A COPY OF ITS PRELIMINARY ANALYSIS AND A COPY OF THE APPLICATION WITH ALL ACCOMPANYING DATA FOR PUBLIC INSPECTION. THE DIVISION SHALL RECEIVE AND CONSIDER PUBLIC COMMENT THEREON FOR A PERIOD OF THIRTY (30) DAYS THEREAFTER. (66-31-12(4)(d).

b-1. NEW AIR CONTAMINATION SOURCES SUBJECT TO PUBLIC COMMENT SHALL BE LIMITED TO THOSE WHOSE ANNUAL EMISSION EXCEEDS TWENTY-FIVE (25) TONS OF ANY ONE POLLUTANT FOR WHICH THE COMMISSION HAS ADOPTED EMISSION REGULATIONS.

c. WITHIN THIRTY (30) DAYS FOLLOWING THE PERIOD FOR PUBLIC COMMENT, OR WITHIN FIFTEEN (15) DAYS AFTER THE PREPARATION OF ITS PRELIMINARY ANALYSIS WHERE NO DELAY FOR PUBLIC COMMENT IS REQUIRED, THE DIVISION SHALL GRANT OR DENY THE PERMIT BASED UPON THE STANDARDS SET FORTH IN PARAGRAPH E.2 OF THIS REGULATION. ANY PERMIT ISSUED BY THE DIVISION MAY CONTAIN SUCH TERMS AND CONDITIONS AS IT DEEMS NECESSARY FOR THE PROPOSED PROJECT OR ACTIVITY TO QUALIFY FOR A PERMIT. IF ANY OF SUCH TERMS OR CONDITIONS OF THE PERMIT ARE VIOLATED, THE DIVISION MAY REVOKE THE PERMIT. IF THE DIVISION FAILS TO ACT UPON THE APPLICATION WITHIN THE PRESCRIBED TIME THE PERMIT SHALL BE DEEMED TO HAVE BEEN GRANTED. (66-31-12(4)(e).

d. IF THE DIVISION DENIES OR REVOKES A PERMIT, THE APPLICANT MAY REQUEST A CONFERENCE WITH THE COMMISSION OR A HEARING BEFORE THE COMMISSION IN ACCORDANCE WITH THE PROVISIONS OF SECTION 66-31-16. THIS APPEAL SHALL BE ADMINISTERED AS STATED BY THE COMMISSION'S POLICY STATEMENT IN APPENDIX TO THESE REGULATIONS.

e. WITHIN THIRTY (30) DAYS AFTER SUCH CONFERENCE OR HEARING, THE COMMISSION OR VARIANCE BOARD SHALL ISSUE AN ORDER EITHER AFFIRMING OR REVERSING THE DECISION OF THE DIVISION. IF THE DECISION OR REVOCATION OF THE DIVISION IS REVERSED, THE COMMISSION OR VARIANCE BOARD SHALL ORDER THE ISSUANCE OR REINSTATEMENT OF THE PERMIT WHICH ORDER MAY CONTAIN SUCH TERMS AND CONDITIONS AS SHALL BE NECESSARY AND REASONABLE. IF A CONFERENCE IS REQUESTED IN LIEU OF A HEARING, THE APPLICANT MAY REQUEST A HEARING THEREAFTER IF THE APPLICANT IS NOT SATISFIED WITH THE RESULTS OF SUCH CONFERENCE. (66-31-12(4)(h).

4. EXPIRATION OF AUTHORITY TO CONSTRUCT:

THE DIVISION MAY CANCEL AN AUTHORITY TO CONSTRUCT OR MODIFY IF THE CONSTRUCTION OR MODIFICATION IS NOT BEGUN WITHIN SIX (6) MONTHS FROM THE DATE CONSTRUCTION IS TO BE STARTED AS STATED IN THE APPLICATION OR IF THE WORK INVOLVED IN THE CONSTRUCTION OR MODIFICATION IS SUSPENDED FOR SIX (6) MONTHS OR MORE. AN APPLICANT MAY SECURE AN EXTENSION OF THE EXPIRATION DATE BY WRITTEN REQUEST TO THE DIVISION STATING THE REASONS FOR THE REQUEST. EXTENSIONS MAY BE GRANTED FOR A PERIOD OF NOT MORE THAN SIX (6) MONTHS.

5. COMMENCEMENT OF OPERATION:

"No person shall commence the operation of any project or the conduct of any activity for which a permit has been issued without giving at least thirty days prior notice to the division of the date on which such commencement is to take place. During such thirty-day period and again within thirty days after commencement, the division shall inspect the project or activity to determine whether or not the terms and conditions of the permit have been properly satisfied. If the division finds that the terms or conditions of the permit have been violated it may revoke the permit, or it may grant a period of not more than six months in which the terms or conditions may be satisfied. If the division determines that the terms and conditions of the permit have not been satisfied within such period of time, the division shall revoke the permit. If the division determines that the terms and conditions of the permit have been satisfied, the division shall grant its final approval of the permit whereupon all requirements of this subsection (4) shall have been fulfilled by the applicant." (Section 66-31-12(4)(i) of the State Act).

F. IMPACT STATEMENT -

1. FOR ALL DIRECT AIR POLLUTION SOURCES EXCEPT THOSE EXEMPT BY PARAGRAPH C.2 AN IMPACT STATEMENT SHALL BE SUBMITTED TO THE DIVISION WITH THE APPLICATION FOR AUTHORITY TO CONSTRUCT WHICH INCLUDES AN AIR CONTAMINANT EMISSION NOTICE AS SHOWN IN ARTICLE I OF THIS REGULATION NO. 3. ADDITIONALLY THE FOLLOWING INFORMATION SHALL BE REQUIRED IF SPECIFIED BY THE DIVISION AT THE TIME OF THE PREPLANNING REVIEW.

   a. INFORMATION ON THE IMPACT OF THE NEW OR MODIFIED SOURCE UPON AIR QUALITY IN POLITICAL SUBDIVISIONS ADJACENT TO THAT IN WHICH THE SOURCE IS TO BE LOCATED AS SPECIFIED BY THE DIVISION AT THE PREPLANNING REVIEW.

   b. DATA ON PRESENT AIR QUALITY, TOPOGRAPHY, METEOROLOGY AND EMISSIONS FROM OTHER SOURCES IN THE AFFECTED AREA AS SPECIFIED BY THE DIVISION AT THE PREPLANNING REVIEW.

c. THE APPLICANT SHALL USE MODELING TECHNIQUES FOR APPROXIMATING THE EFFECTS OF THE ACTIVITY UPON AIR QUALITY IF SPECIFIED BY THE DIVISION AT THE PREPLANNING REVIEW. FOR THE PURPOSES OF UNIFORMITY THE DIVISION SHALL SPECIFY MODELING TECHNIQUES AND PROCEDURES TO BE USED.

d. TWO COPIES OF THE COMPLETE DATA, SITING (LOCATION) INFORMATION, PLANS, DESCRIPTIONS, SPECIFICATIONS AND DRAWINGS SUFFICIENT IN SCOPE TO ALLOW AN ENGINEERING EVALUATION TO BE MADE TO DETERMINE WHETHER APPROPRIATE AIR POLLUTION CONTROL REGULATIONS, AND ORDINANCES AND AMBIENT AIR QUALITY CONTROL STANDARDS WILL BE MET. FOR CERTAIN CLASSES OF EQUIPMENT, SPECIAL INSTRUCTION FORMS ARE AVAILABLE WHICH DETAIL THE INFORMATION REQUIRED. THESE FORMS CAN BE IDENTIFIED AS THE FORM 200A SERIES.

e. SUCH PERFORMANCE TESTS RESULTS, INFORMATION AND RECORDS AS MAY BE REQUIRED BY THE DIVISION TO DETERMINE WHETHER THE REQUIREMENTS OF THIS REGULATION ARE MET. SUCH INFORMATION MAY ALSO BE REQUIRED BY THE DIVISION AT ANY TIME WHEN THE SOURCE IS BEING OPERATED TO DETERMINE COMPLIANCE WITH APPLICABLE EMISSION CONTROL REGULATIONS AND AMBIENT AIR QUALITY STANDARDS.

PROPOSED REVISIONS TO REGULATION NO. 3

III. INDIRECT AIR CONTAMINATION SOURCES

A. GENERAL.

SUBJECT TO THE FOLLOWING PROVISIONS, THIS REGULATION NO. 3 SHALL APPLY TO INDIRECT AIR CONTAMINATION SOURCES. SOURCES WHICH MEET THE DEFINITION OF BOTH DIRECT AND INDIRECT AIR CONTAMINATION SOURCES SHALL BE SUBJECT TO DUAL CONTROLS AND PERMIT REQUIREMENTS UNDER THIS REGULATION.

B. APPLICATION AND EFFECTIVE DATE

THIS ARTICLE III SHALL APPLY STATEWIDE WITH THE EXCEPTION OF THE COUNTIES OF ADAMS, ARAPAHOE, BOULDER, CLEAR CREEK, DENVER, DOUGLAS, GILPIN AND JEFFERSON, WHICH COUNTIES ARE THE SUBJECT OF A SEPARATE ARTICLE UNDER THIS REGULATION NO. 3. THE PROVISIONS OF THIS ARTICLE III SHALL BE EFFECTIVE JANUARY 1, 1975.

C. DEFINITIONS AND EXCEPTIONS

1. THE TERM "INDIRECT AIR CONTAMINATION SOURCE" SHALL INCLUDE REGARDLESS OF SIZE OR NUMBER OF UNITS, COMMERCIAL FACILITIES, PUBLIC AND PRIVATE OFFICE BUILDINGS, SPORTS COMPLEXES, AIRPORTS, RESTAURANTS, MEDICAL CARE FACILITIES, APARTMENT OR CONDOMINIUM COMPLEXES, SUBDIVISIONS OF SINGLE OR MULTIPLE-FAMILY DWELLING UNITS, PARKING LOTS, ROADWAYS, OR OTHER STRUCTURES WHOSE PATRONAGE RELIES WHOLLY OR IN PART, ON THE USE OF MOTOR VEHICLES.
2. THE FOLLOWING INDIRECT AIR CONTAMINATION SOURCES ARE EXEMPT FROM THE REQUIREMENTS OF THIS ARTICLE III IF THEIR SOLE SOURCE OF AIR CONTAMINANTS IS A RESULT OF MOTOR VEHICLE TRAFFIC GENERATED BY THE SOURCE.
   a. NEW PARKING FACILITIES TO ACCOMMODATE 1,000 AUTOMOBILES OR LESS AT ANY ONE TIME OR EXISTING FACILITIES TO BE MODIFIED TO INCREASE PARKING CAPACITY BY 500 AUTOMOBILES OR LESS.

d. Parking facilities used exclusively for public or private mass transportation.

c. NEW MOTOR VEHICLE ROADWAYS WITH AN ANTICIPATED ANNUAL AVERAGE DAILY TRAFFIC VOLUME OF 20,000 OR LESS VEHICLES PER DAY WITHIN 10 YEARS OF CONSTRUCTION OR A SIMILAR ESTIMATED INCREASE OF 10,000 ADDITIONAL VEHICLES PER DAY IN THE CASE OF A ROADWAY MODIFICATION.

d. LOCATION OR RELOCATION OF ANY MAJOR DEVELOPMENT, PRIVATE OR PUBLIC ENTERPRISE EMPLOYING LESS THAN 500 PERSONS AT ANY ONE TIME.

e. RESIDENTIAL DEVELOPMENTS OF LESS THAN 250 SINGLE-FAMILY DWELLING UNITS.

f. AIRPORTS, OR ENLARGEMENTS TO ANY AIRPORT, WHOSE TOTAL OPERATION AMOUNTS TO LESS THAN 50,000 TAKEOFFS AND LANDINGS PER YEAR OR USED BY 1,600,000 OR LESS PASSENGERS PER YEAR.

3. WHERE AN INDIRECT SOURCE IS CONSTRUCTED OR MODIFIED IN INCREMENTS WHICH INDIVIDUALLY ARE NOT SUBJECT TO REVIEW UNDER THIS ARTICLE, ALL SUCH INCREMENTS OCCURRING SINCE THE EFFECTIVE DATE OF THIS REGULATION, OR SINCE THE LATEST APPROVAL HEREUNDER, WHICHEVER DATE IS MOST RECENT, SHALL BE ADDED TOGETHER FOR DETERMINING THE APPLICABILITY OF THIS ARTICLE.

4. THE PHRASE "TO COMMENCE CONSTRUCTION" MEANS TO ENGAGE IN A CONTINUOUS PROGRAM OF CONSTRUCTION INCLUDING SITE CLEARANCE, GRADING, DREDGING, OR LAND FILLING SPECIFICALLY DESIGNED FOR AN INDIRECT SOURCE IN PREPARATION FOR THE FABRICATION, ERECTION, OR INSTALLATION OF THE BUILDING COMPONENTS OF THE INDIRECT SOURCE. INTERRUPTIONS RESULTING FROM ACTS OF GOD, STRIKES, LITIGATION, OR OTHER MATTERS BEYOND THE CONTROL OF THE OWNER SHALL BE DISREGARDED IN DETERMINING WHETHER A CONSTRUCTION OR MODIFICATION PROGRAM IS CONTINUOUS.

5. THE PHRASE "TO COMMENCE MODIFICATION" MEANS TO ENGAGE IN A CONTINUOUS PROGRAM OF MODIFICATION, INCLUDING SITE CLEARANCE, GRADING, DREDGING, OR LAND FILLING IN PREPARATION FOR A SPECIFIC MODIFICATION OF THE INDIRECT SOURCE.

6. THE FOLLOWING ADMINISTRATIVE PROCEDURES AND STATEMENTS CONSTITUTE THE MECHANICS OF THE PERMIT SYSTEM UNDER THIS ARTICLE:

   a. PREPLANNING REVIEW

   b. AUTHORITY TO CONSTRUCT

   c. IMPACT STATEMENT

D. PREPLANNING REVIEW

1. PRIOR TO SUBMITTING AN APPLICATION FOR AUTHORITY TO CONSTRUCT, THE APPLICANT SHALL MAKE A REQUEST TO THE DIVISION FOR A PREPLANNING REVIEW.

2. THIS PREPLANNING REVIEW, AT THE DISCRETION OF THE DIVISION, MAY BE A TELEPHONE DISCUSSION, A MEETING, A SITE INSPECTION, OR COMBINATION THEREOF, FOR THE PURPOSE OF EXCHANGING CONTROL REQUIREMENT INFORMATION, AIR MONITORING AND AIR POLLUTION PREDICTIVE MODELING REQUIREMENTS, AND DISCUSSING OTHER REQUIREMENTS AS OUTLINED IN PARAGRAPH E (AUTHORITY TO CONTRUCT). SUCH REVIEW IS ADVISABLE PRIOR TO LARGE SCALE PLANNING AND DESIGN EXPENDITURES ON BEHALF OF THE APPLICANT TO DISCUSS WITH THE DIVISION IN CONCEPTUAL TERMS THE NATURE AND SCOPE OF THE PROPOSED PROJECT AS RELATING TO AIR POLLUTION CONTROL REQUIREMENTS. THE DIVISION SHALL ADVISE THE APPLICANT IN WRITING THAT ITS CONCLUSIONS ARE ADVISORY IN NATURE TO THE APPLICANT FOR ASSISTING LATER REVIEW OF THE FORMAL APPLICATION FOR AUTHORITY TO CONSTRUCT.

3. BEFORE A FORMAL APPLICATION FOR A PERMIT TO CONSTRUCT WILL BE ISSUED, DATA ON PRESENT AIR QUALITY, TOPOGRAPHY, METEOROLOGY AND EMISSIONS FROM OTHER SOURCES IN THE AFFECTED AREA MUST BE SUBMITTED TO THE DIVISION IN AN IMPACT STATEMENT PER PARAGRAPH F. ANY DATA ON PRESENT AIR QUALITY, METEOROLOGY AND EMISSIONS FROM THE OTHER SOURCES IN THE AREA WHICH THE DIVISION HAS OBTAINED FROM EMISSION INVENTORIES, PREVIOUS SAMPLING PROGRAMS OR OTHER MEANS SHALL BE MADE AVAILABLE TO THE APPLICANT IN CONJUNCTION WITH THE PREPLANNING REVIEW AS AN AID IN PREPARING THE IMPACT STATEMENT.

4. THE DIVISION MAY REQUIRE AMBIENT AIR MONITORING FOR A PERIOD OF UP TO TWELVE (12) MONTHS BY APPLICANT PRIOR TO FILING OF APPLICATION FOR AUTHORITY TO CONSTRUCT, BUT SHALL SPECIFY THE MINIMUM PERIOD AND TIME OF YEAR FOR AIR MONITORING SUFFICIENT TO ESTIMATE BACKGROUND LEVELS OF MAJOR AIR CONTAMINANTS.

E. AUTHORITY TO CONSTRUCT

1. GENERAL REQUIREMENT

   a. NO PERSON SHALL CONSTRUCT OR MODIFY ANY INDIRECT AIR CONTAMINANT EMISSION SOURCE WITHOUT FILING AN APPLICATION FOR AUTHORITY TO CONSTRUCT AND RECEIVING WRITTEN AUTHORIZATION FROM THE DIVISION EXCEPT AS EXEMPTED PER PARAGRAPH C.2.

   b. TOGETHER WITH THE APPLICATION, THE APPLICANT SHALL SUBMIT A DETAILED STATEMENT OF AIR POLLUTION IMPACT (IMPACT STATEMENT) OF THE PROPOSED ACTION AS DESCRIBED IN PARAGRAPH F.

   c. APPLICATIONS SHALL BE SIGNED BY THE INDIVIDUAL LEGALLY RESPONSIBLE AND AUTHORIZED TO DO SO, AND HE THEREBY COVENANTS THAT THE APPLICANT WILL EITHER CONSTRUCT OR MODIFY THE AIR CONTAMINATION SOURCE IN ACCORDANCE WITH THE REQUIREMENTS FOR GRANTING APPLICANTS AS OUTLINED IN THIS REGULATION.

2. STANDARDS FOR GRANTING OR DENYING APPLICATIONS

a. NO AUTHORITY TO CONSTRUCT SHALL BE GRANTED TO THE APPLICANT UNLESS THE DIVISION DETERMINES TO ITS SATISFACTION THAT:

(i) THE NEW INDIRECT AIR CONTAMINATION SOURCE IS DESIGNED, BUILT, AND EQUIPPED IN ACCORDANCE WITH THE BEST AVAILABLE TECHNOLOGY AND OTHER ALTERNATIVES TO REDUCE, PREVENT, AND CONTROL AIR POLLUTION.

(ii) THE INDIRECT AIR CONTAMINATION SOURCE, AS DESIGNED OR MODIFIED, DOES NOT SIGNIFICANTLY ENDANGER MAINTENANCE OR ATTAINMENT OF ANY AMBIENT AIR QUALITY STANDARDS OF THE COMMISSION, AND ANY MORE STRINGENT NATIONAL OR LOCAL AMBIENT AIR QUALITY STANDARDS.

(iii) IF THE CONDITIONS OF (i) and (ii) OF THIS SECTION CANNOT BE MET, YET THE APPLICANT UTILIZES THE BEST AVAILABLE TECHNOLOGY AND OTHER ALTERNATIVES, WHICH WOULD SIGNIFICANTLY REDUCE OR MINIMIZE POLLUTION, THE DIVISION SHALL CONSULT WITH THE COMMISSION AND THEREAFTER THE DIVISION, WITH THE CONCURRENCE OF THE COMMISSION OR THE COMMISSION ALONE, MAY GRANT THE PERMIT.

(iv) APPROVAL OF A PERMIT APPLICATION SHALL NOT EXEMPT APPLICANT FROM THE RESPONSIBILITY TO COMPLY WITH APPLICABLE PORTIONS OF THE CONTROL STRATEGY INCLUDED IN COLORADO STATE IMPLEMENTATION PLANS.

b. CONDITIONAL APPROVAL OF APPLICATIONS

(i) AN AUTHORITY TO CONSTRUCT OR MODIFY MAY BE ISSUED TO AN APPLICANT OWNING OR OPERATING ANY INDIRECT AIR CONTAMINATION SOURCE SUBJECT TO CONDITIONS WHICH WILL MAKE THE SOURCE OPERATE WITHIN THE EMISSION CONTROL REGULATIONS AND AMBIENT AIR QUALITY STANDARDS OF THE COMMISSION OR APPLICABLE NATIONAL OR LOCAL AIR POLLUTION CONTROL ORDINANCES AND REGULATIONS, AND AMBIENT AIR QUALITY STANDARDS, IN WHICH CASE THE CONDITIONS WILL BE SPECIFIED IN WRITING. COMMENCING WORK UNDER SUCH AN AUTHORITY TO CONSTRUCT SHALL BE DEEMED ACCEPTANCE BY THE APPLICANT OF ALL CONDITIONS SPECIFIED.

(ii) THE DIVISION MAY IMPOSE CONDITIONS UPON THE APPLICANT IN THE AUTHORITY TO CONSTRUCT OR MODIFY WHICH REQUIRE OWNERS OR OPERATORS OF INDIRECT AIR CONTAMINATION SOURCES TO INSTALL, MAINTAIN, AND USE INSTRUMENTATION TO MONITOR AND RECORD EMISSION, AMBIENT AIR AND/OR VEHICLE TRAFFIC DATA AS A BASIS FOR PERIODIC REPORTS TO THE DIVISION.

c. DENIAL OF AN APPLICATION

(i) IN THE EVENT OF A DENIAL OF AN APPLICATION THE DIVISION SHALL NOT ACCEPT A FURTHER APPLICATION UNLESS THE APPLICANT HAS COMPLIED WITH THE OBJECTIONS SPECIFIED AS REASONS FOR DENIAL.

(ii) PRIOR TO THE APPLICANT BEING NOTIFIED, IN WRITING, OF DENIAL, A CONFERENCE BETWEEN THE DIVISION AND THE APPLICANT MAY BE HELD TO DISCUSS THE REASONS FOR DENIAL.

3. REQUIREMENTS FOR REVIEWING APPLICATIONS

a. THE DIVISION SHALL PREPARE ITS PRELIMINARY ANALYSIS OF THE EFFECT UPON THE AMBIENT AIR QUALITY AND THE EXTENT OF EMISSION CONTROL WITHIN TWENTY (20) DAYS AFTER DATE ON WHICH AN APPLICATION IS FILED. (66-31-12(4)(c).

b. FOR THOSE TYPES OF PROJECTS OR ACTIVITIES DEFINED OR DESIGNATED BY THE COMMISSION AS WARRANTING PUBLIC COMMENT WITH RESPECT THERETO, AS STATED IN PARAGRAPH b-1 OF THIS SUBSECTION (b), THE DIVISION SHALL, WITHIN FIFTEEN (15) DAYS AFTER IT HAS PREPARED ITS PRELIMINARY ANALYSIS, GIVE PUBLIC NOTICE OF THE PROPOSED PROJECT OR ACTIVITY BY AT LEAST ONE PUBLICATION IN THE NEWSPAPER OF GENERAL CIRCULATION IN THE COUNTY IN WHICH THE PROPOSED PROJECT OR ACTIVITY, OR A PART THEREOF, IS TO BE LOCATED. IF NO QUALIFIED NEWSPAPER IS PUBLISHED WITHIN SUCH COUNTY, THEN THE PUBLICATION SHALL BE MADE IN A NEWSPAPER PUBLISHED IN AN ADJOINING OR NEARBY COUNTY. THE DIVISION SHALL ALSO WITHIN SUCH PERIOD OF TIME MAINTAIN IN THE OFFICE OF THE COUNTY CLERK AND RECORDER OF THE COUNTY IN WHICH THE PROPOSED PROJECT OR ACTIVITY, OR A PART THEREOF, IS LOCATED A COPY OF ITS PRELIMINARY ANALYSIS AND A COPY OF THE APPLICATION WITH ALL ACCOMPANYING DATA FOR PUBLIC INSPECTION. THE DIVISION SHALL RECEIVE AND CONSIDER PUBLIC COMMENT THEREON FOR A PERIOD OF THIRTY (30) DAYS THEREAFTER. (66-31-12(4)(d).

INDIRECT AIR CONTAMINATION SOURCES SUBJECT TO PUBLIC COMMENT SHALL INCLUDE THOSE COVERED BY THIS ARTICLE III.

c. WITHIN THIRTY (30) DAYS FOLLOWING THE PERIOD FOR PUBLIC COMMENT, OR WITHIN FIFTEEN (15) DAYS AFTER THE PREPARATION OF ITS PRELIMINARY ANALYSIS WHERE NO DELAY FOR PUBLIC COMMENT IS REQUIRED, THE DIVISION SHALL GRANT OR DENY THE PERMIT BASED UPON THE STANDARDS SET FORTH IN PARAGRAPH E.2 OF THIS REGULATION. ANY PERMIT ISSUED BY THE DIVISION MAY CONTAIN SUCH TERMS AND CONDITIONS AS IT DEEMS NECESSARY FOR THE PROPOSED PROJECT OR ACTIVITY TO QUALIFY FOR A PERMIT. IF ANY OF SUCH TERMS OR CONDITIONS OF THE PERMIT ARE VIOLATED, THE DIVISION MAY REVOKE THE PERMIT. IF THE DIVISION FAILS TO ACT UPON THE APPLICATION WITHIN THE PRESCRIBED TIME, THE PERMIT SHALL BE DEEMED TO HAVE BEEN GRANTED. (66-31-12(4)(e).

d. IF THE DIVISION DENIES OR REVOKES A PERMIT, THE APPLICANT MAY REQUEST A CONFERENCE WITH THE DIVISION OR A HEARING BEFORE THE COMMISSION IN ACCORDANCE WITH THE PROVISIONS OF SECTION 66-31-16. THIS APPEAL SHALL BE ADMINISTERED AS STATED BY THE COMMISSION'S POLICY STATEMENT V IN THE APPENDIX OF THESE REGULATIONS.

e. WITHIN THIRTY (30) DAYS AFTER SUCH CONFERENCE OR HEARING, THE COMMISSION OR VARIANCE BOARD SHALL ISSUE AN ORDER EITHER AFFIRMING OR REVERSING THE DECISION OF THE DIVISION. IF THE DECISIONS OR REVOCATION OF THE DIVISION IS REVERSED, THE COMMISSION OR VARIANCE BOARD SHALL ORDER THE ISSUANCE OR REINSTATEMENT OF THE PERMIT WHICH ORDER MAY CONTAIN SUCH TERMS AND CONDITIONS AS SHALL BE NECESSARY AND REASONABLE. IF A CONFERENCE IS REQUESTED IN LIEU OF A HEARING, THE APPLICANT MAY REQUEST A HEARING THEREAFTER IF THE APPLICANT IS NOT SATISFIED WITH THE RESULTS OF SUCH CONFERENCE. (66-31-12(4)(h).

4. EXPIRATION OF AUTHORITY TO CONSTRUCT

THE DIVISION MAY CANCEL AN AUTHORITY TO CONSTRUCT OR MODIFY IF THE CONSTRUCTION OR MODIFICATION IS NOT BEGUN WITHIN SIX (6) MONTHS FROM THE DATE CONSTRUCTION IS TO BE STARTED AS STATED IN THE APPLICATION OR IF THE WORK INVOLVED IN THE CONSTRUCTION OR MODIFICATION IS SUSPENDED FOR SIX (6) MONTHS OR MORE. AN APPLICANT MAY SECURE AN EXTENSION OF THE EXPIRATION DATE BY WRITTEN REQUEST TO THE DIVISION STATING THE REASONS FOR THE REQUEST. EXTENSIONS MAY BE GRANTED FOR A PERIOD OF NOT MORE THAN SIX (6) MONTHS.

5. COMMENCEMENT OF OPERATION

"No person shall commence the operation of any project or the conduct of any activity for which a permit has been issued without giving at least thirty days prior notice to the division of the date on which such commencement is to take place. During such thirty-day period and again within thirty days after commencement the division shall inspect the project or activity to determine whether or not the terms and conditions of the permit have been properly satisfied. If the division finds that the terms or conditions of the permit have been violated it may revoke the permit, or it may grant a period of not more than six months in which the terms or conditions may be satisfied. If the division determines that the terms and conditions of the permit have not been satisfied within such period of time, the division shall revoke the permit. If the division determines that the terms and conditions of the permit have been satisfied, the division shall grant its final approval of the permit whereupon all requirements of this subsection (4) shall have been fulfilled by the applicant. (Section 66-31-12(4)(i) of State Act).

F. IMPACT STATEMENT

1. FOR ALL INDIRECT AIR POLLUTION SOURCES EXCEPT THOSE EXEMPT BY PARAGRAPH C.2, AN IMPACT STATEMENT COVERING THE FOLLOWING SHALL BE SUBMITTED WITH THE APPLICATION FOR AUTHORITY TO CONSTRUCT:

   a. INFORMATION ON THE IMPACT OF THE NEW OR MODIFIED SOURCE UPON AIR QUALITY IN POLITICAL SUBDIVISIONS ADJACENT TO THAT IN WHICH THE SOURCE IS TO BE LOCATED.

b. DATA ON PRESENT AIR QUALITY, TOPOGRAPHY, METEOROLOGY AND EMISSIONS FROM OTHER SOURCES IN THE AFFECTED AREA.

c. INFORMATION ON THE SIZE OF THE SOURCE AND TIMES OF OPERATION WHEN DEEMED ADVISABLE BY THE DIVISION, THE APPLICANT SHALL USE MODELING TECHNIQUES FOR APPROXIMATING THE EFFECTS OF THE ACTIVITY UPON AIR QUALITY. FOR PURPOSES OF UNIFORMITY THE DIVISION SHALL SPECIFY MODELING TECHNIQUES AND PROCEDURES TO BE USED.

2. IN ADDITION, THE FOLLOWING INFORMATION MUST BE INCLUDED IN THE STATEMENT SUBMITTED:

a. ANTICIPATED NUMBER OF EMPLOYEES AND PATRONS, EXPECTED TRANSPORTATION ROUTES, MODES, AND TRANSPORTATION HABITS OF EMPLOYEES AND PATRONS, AND NUMBER OF HOUSING UNITS AND ESTIMATED NUMBER OF RESIDENTS.

b. ESTIMATION OF THE EFFECT OF THE PROPOSED ACTIVITY UPON CHANGES IN THE VEHICLE MILES TRAVELED (V.M.T.) PATTERN IN THE GENERAL AREA; THE EFFECT UPON GENERATING SECONDARY BUSINESS, COMMERCIAL AND RESIDENTIAL ACTIVITY IN THE GENERAL AREA; AND CONSIDERATION TO THE SPATIAL DISTRIBUTION OF MOTOR VEHICLE MOVEMENT; HEIGHT OF EMISSIONS AND ANY FACILITY CONFIGURATION WHICH WOULD CONSTRAIN DISPERSION OF POLLUTANTS (SUCH AS A PARKING DECK).

c. EFFECTIVE JULY 1, 1975, UNLESS EXEMPTED BY THE DIVISION ALL INDIRECT SOURCES SHALL USE TRANSPORTATION MODELING TECHNIQUES AS DEVELOPED BY THE DIVISION FOR APPROXIMATING THE EFFECTS UPON AIR QUALITY OF FACILITIES WITH ASSOCIATED MOBILE SOURCE ACTIVITY.

d. APPLICANT SHALL DEMONSTRATE TO THE DIVISION THAT MOTOR VEHICLE TRAFFIC HAS BEEN OR WILL BE MINIMIZED BY THE FOLLOWING, WHEN APPLICABLE:

(i) MAXIMUM UTILIZATION OF PUBLIC AND PRIVATE MASS TRANSPORTATION SYSTEMS AND PROVISIONS RELATING TO REGULATIONS FOR EXPRESS BUS SERVICE AND EXCLUSIVE BUS LANES.

(ii) CONSIDERATION OF ALTERNATE BUILDING SITES AND ACTIVITY LOCATIONS (FOR EXAMPLE, CONSTRUCTING NEXT TO PUBLIC TRANSPORTATION ROUTES AS OPPOSED TO RELIANCE UPON MOTOR VEHICLE ROADWAYS).

(iii) USE OF TRAFFIC SIGNALIZATION AND CONTROL TECHNIQUES TO REDUCE VEHICLE TRAFFIC OR TO IMPROVE VEHICLE FLOW.

(iv) LIMITING THE USE OF MOTOR VEHICLE PARKING SPACES AND ADJUSTING PARKING FEES SO AS TO ENCOURAGE CAR POOLING AND TO DISCOURAGE SINGLE OCCUPANCY COMMUTER VEHICLES.

(v) DEVELOPMENT AND USE OF A CAR POOLING SERVICE.

(vi) USE OF AUTOMOBILE-FREE ZONES.

(vii) CONSTRUCTION OF BIKEWAYS AND BICYCLE PARKING FACILITIES.

PROPOSED ADDITIONS
TO
REGULATION NO. 3
(Permit System)

IV. PORTABLE EMISSION SOURCES:

1. FOR PURPOSES OF THIS SECTION PORTABLE EMISSION SOURCES MAY INCLUDE BUT SHALL NOT BE LIMITED TO ASPHALT AND ROCK CRUSHING PLANTS, CONCRETE BATCH PLANTS, QUARRY WAGON DRILLS AND ROOFING ASPHALT KETTLES.

2. ALL EXISTING SOURCES INCLUDED IN PARAGRAPH 1 OF THIS SECTION SHALL BE TREATED AS NEW SOURCE INSOFAR AS ANY PERSON OWNING SAID SOURCES SHALL BY SEPTEMBER 1, 1974, OBTAIN A PERMIT FOR EXISTING EQUIPMENT FROM THE DIVISION PURSUANT TO THIS SECTION. NEW SOURCES SHALL ALSO APPLY IN ACCORDANCE WITH THE PROCEDURES OF THIS SECTION.

   a. THE PERMIT MAY BE GRANTED AND RENEWED FOR ANY PERIOD OF TIME AS DEEMED APPROPRIATE BY THE DIVISION.

b. THE PERMIT MAY BE GRANTED TO ANY SINGLE APPLICANT FOR ANY SINGLE PROJECT OR COMBINATION OF PROJECTS AS DEEMED APPROPRIATE BY THE DIVISION.

b-1. WITH RESPECT TO ROOFING ASPHALT KETTLES AND QUARRY WAGON DRILLS, A SINGLE PERMIT ISSUED PURSUANT TO THIS SECTION IV.2 MAY BE ISSUED FOR MORE THAN ONE UNIT BELONGING TO A SINGLE APPLICANT PROVIDING ALL UNITS ADHERE TO THE PROVISIONS OF I.A.1 OF THIS REGULATION NO. 1.

c. SOURCE RELOCATIONS -

EXCEPT FOR QUARRY WAGON DRILLS AND ROOFING ASPHALT KETTLES, ANY PERSON HAVING BEEN GRANTED A PERMIT, SHALL NOTIFY THE DIVISION THIRTY (30) DAYS IN ADVANCE OF EACH SOURCE RELOCATION. SAID NOTIFICATION SHALL INCLUDE THE FOLLOWING INFORMATION:

c-1 LOCATION AND EXPECTED DURATION AT RELOCATION SITE,

c-2 FUEL CHANGE IF ANY,

c-3 TYPE, MATERIAL SIZE RANGE AND MOISTURE CONTENT OF MATERIAL TO BE PROCESSED AS RELATED TO AIR POLLUTION POTENTIAL,

c-4 AFTER REVIEW OF THE NOTICE BY THE DIVISION ADDITIONAL CONTROL MEASURES IF DEEMED NECESSARY BY THE DIVISION.

APPENDIX F

THE COLORADO PLAN FOR
FEDERAL SECONDARY AMBIENT AIR QUALITY STANDARDS
(PARTICULATE MATTER AND SULFUR OXIDES)
Adopted February 28, 1974

PARTICULATE MATTER

Plan Summary and Implementation Schedule:

The Colorado Air Pollution Control Commission adopted for public hearing proposals of the "Colorado Fugitive Dust Investigation" report as the Colorado plan for the Federal secondary ambient air quality standard for particulate matter. This report was prepared by PEDCo-ENVIRONMENTAL of Cincinnati, Ohio, under contract to the Environmental Protection Agency. The Commission considers the three regions studies in this report as typical of the problem statewide. The Commission agreed with the consultant's recommendations on the practical controls available and adopted all recommendations formally outlined in the report as regulation on March , 1974. However the Commission remains uncertain of the means by which fugitive dust emissions can be further reduced from snow sanding by 25% as a result of quicker sand pickup by machine sweeping after snow melt. To this end, the Commission has solicited information on the sand pickup problem from the State Highway Department and local governments within the Denver Metropolitan area and has deemed immediate controls undefinable on the basis of the public hearing record and other information received at this time. The Commission requests twelve (12) additional months to study this matter in more depth and to submit a control regulation if the Environmental Protection Agency and the Commission concludes control measures are available and reasonable considering the public safety problem.

Following is an outline of the Commission's plan for the Federal Secondary Standard for Particulate Matter:

November 27, 1973 -

Commission adopted for purposes of public hearing, Secondary Standards Plan. Legal notice sent to 600 organization and news release.

January 7, 1974 -

Commission held public hearing on the proposed plan according to the attached Notice of Hearing.

February 28, 1974 -

Commission adopted plan and submitted it, through the Governor, to the Regional Administrator of E.P.A. for approval. As part of that plan, the Commission adopted a fugitive dust control regulation pursuant to public hearings on July 10, 18, 19, 1973 and January 7, 1974 and after receipt of the PEDCo Report recommendations.

August 1, 1974:

Commission to submit additional control plans to E.P.A. regarding the control of fugitive dust from snow-sanding if feasible control measures are identified. The Commission will annually investigate additional particulate matter control measures that may be workable. Additionally, the Commission is amiable to suggestions from the Environmental Protection Agency and any other organization or person as to additional practical control measures, and recommends meetings with E.P.A. officials on such suggestions so plan revisions can be made on mutually agreeable measures.

AIR POLLUTION CONTROL COMMISSION
COLORADO DEPARTMENT OF HEALTH 4210 EAST 11TH AVENUE • DENVER, COLORADO 80220

NOTICE OF PUBLIC HEARING BEFORE THE COLORADO AIR POLLUTION CONTROL COMMISSION ON THE PROPOSED PLAN TO MEET THE FEDERAL SECONDARY STANDARDS FOR PARTICULATE MATTER AND SULFUR OXIDES

Pursuant to the provisions of Colorado Revised Statutes 1963, Section 3-16-2, as amended (1967-1969 Perm.Cum.Supps.) and Section 66-31-5 as amended (1971 Perm.Cum.Supps.) of the "Air Pollution Control Act of 1970, and pursuant to 37 Code of Federal Regulations (CFR) 10855 as amended in 40 CFR Part 52, NOTICE is hereby given that the Colorado Air Pollution Control Commission will hold a public hearing on January 7, 1974 at 9:30 a.m. in the Colorado Division of Highways Auditorium, 4201 East Arkansas, City and County of Denver, Colorado, to consider and act upon the adoption of a proposed plan to meet the Federal Secondary Standards for particulate matter and sulfur oxides in the Federal designated Denver, San Isabel and Pawnee Air Quality Control Regions (consisting of the Front Range and eastern portion of Colorado).

The entire plan is available for public inspection at the office of the Technical Secretary, Colorado Department of Health. A summary of the proposed plan and rules and regulations is attached and also available at the air quality control region offices of the state as follows:

Fort Collins, Colorado
Larimer County Health Department
200 West Oak Street

Denver, Colorado
Colorado Department of Health
4210 East 11th Avenue

La Junta, Colorado
Otero County Health Department
County Court House

Colorado Springs, Colorado
City-County Health Department
501 North Foote Street

Alamosa, Colorado
Alamosa County Clerk
County Court House

Durango, Colorado
San Juan Basin Health Unit
1905 East Third Avenue

Grand Junction, Colorado
Mesa County Health Department
515 Patterson Avenue

Steamboat Springs, Colorado
Routt County Clerk
Routt County Court House

Any interested person shall have an opportunity to participate at said public hearing by submitting written data, views, or arguments or submitting them orally at said public hearing or through legal counsel. It is expected that all speakers will summarize their remarks where proper, and will provide lengthy supportive information in written form for review by the Commission.

Any person desiring to propose amendments to the proposed plan shall file such other proposal with Mr. Lane Kirkpatrick, Technical Secretary to the Commission on or before 5 p.m., January 1, 1974 at the above letterhead address. When on file these proposals shall be open for public inspection.

Witnesses at the hearing shall be subject to cross-examination by or on behalf of the Commission, or by or on behalf of persons who have proposed amendments to the plan and rules and regulations as herein provided.

At such time as no persons are present to offer testimony, the hearing shall be closed and in no event later than 4 p.m.

COLORADO AIR POLLUTION CONTROL COMMISSION

James P Lodge Jr.

Dated December 4, 1973

James P. Lodge, Jr., Ph.D., Chairman

Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220

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Legal Counsel's Office
Colorado Department of Health

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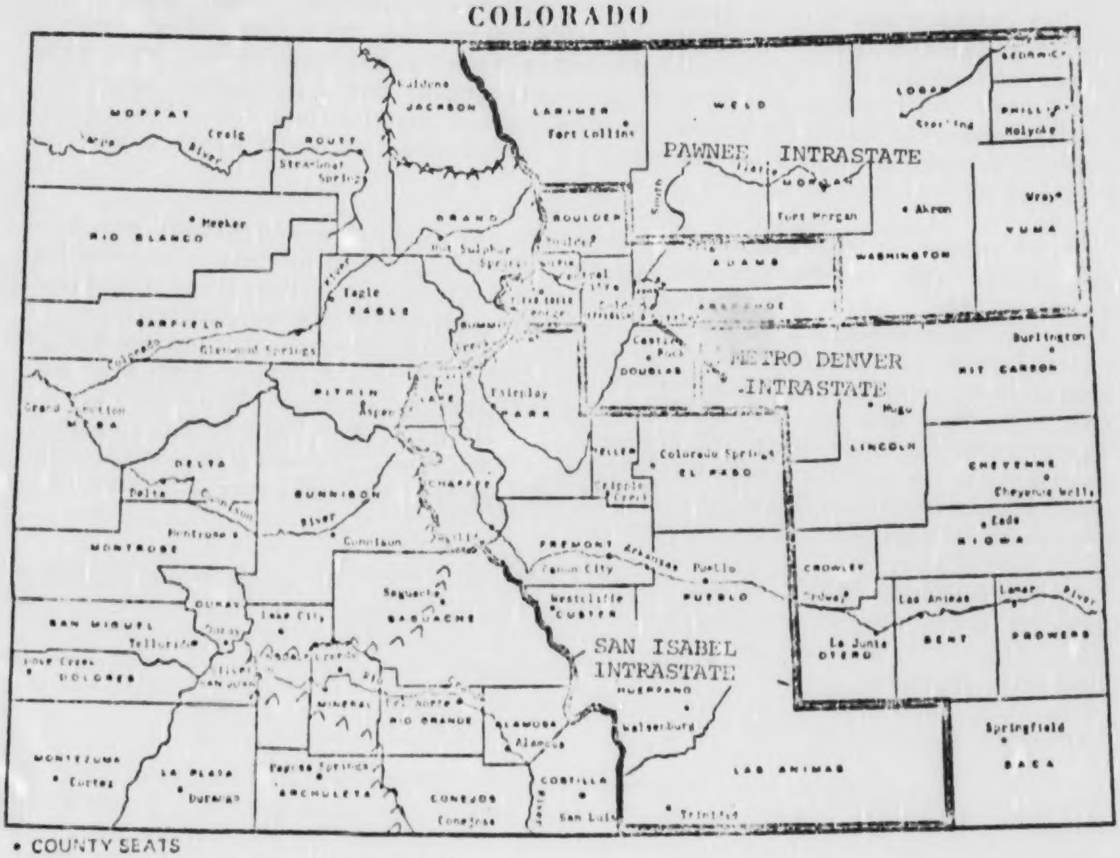
COLORADO
PAWNEE INTRASTATE
METRO DENVER INTRASTATE
SAN ISABEL INTRASTATE
MOFFAT
Craig
JACKSON
LARIMER
Fort Collins
WELD
LOGAN
Sterling
SEDGWICK
PHILLIPS
Holyoke
ROUTT
Steamboat Springs
RIO BLANCO
Meeker
GRAND
Hot Sulphur Springs
BOULDER
MORGAN
Fort Morgan
Akron
WASHINGTON
YUMA
Wray
ADAMS
ARAPAHOE
EAGLE
Eagle
GARFIELD
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Colorado
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PITKIN
Aspen
LAKE
Fairplay
PARK
Hugo
LINCOLN
DELTA
Delta
GUNNISON
Gunnison
CHAFFEE
TELLER
Cripple Creek
Colorado Springs
EL PASO
CHEYENNE
Cheyenne Wells
Eads
KIOWA
MONTROSE
Montrose
FREMONT
Canon City
Arkansas
Pueblo
PUEBLO
CROWLEY
Ordway
OURAY
Ouray
SAN MIGUEL
Telluride
Lake City
Saguache
SAGUACHE
Westcliffe
CUSTER
Las Animas
BENT
Lamar
PROWERS
Rio
DOLORES
Silverton
SAN JUAN
MINERAL
Creede
Del Norte
RIO GRANDE
ALAMOSA
Alamosa
HUERFANO
Walsenburg
La Junta
OTERO
MONTEZUMA
Cortez
LA PLATA
Durango
Pagosa Springs
ARCHULETA
CONEJOS
Conejos
COSTILLA
San Luis
LAS ANIMAS
Trinidad
Springfield
BACA
• COUNTY SEATS

Location of Metro-Denver, Pawnee, and San Isabel AQCR's.

PEDCo REPORT SUMMARY

The entire PEDCo report is available for inspection at the office of the Technical Secretary of the Commission, 4210 East 11th Avenue, Denver, Colorado. Telephone 303-388-6111, Extension 286. The following highlights that report:

Introduction

Prior to submittal in January of 1972 of its initial implementation plan for attainment of particulate air quality standards, the State of Colorado requested and E.P.A. granted an 18-month extension for development of a plan to achieve the secondary standard of 60 micrograms per cubic meter (ug/m^3) annual geometric mean. The particulate control regulations submitted in the initial implementation plan showed that the primary standard would barely be achieved in some areas.

In searching for particulate emission sources where additional emission reductions could be demonstrated as part of the plan to achieve the secondary standard, the Colorado Air Pollution Control Commission identified fugitive dust from unpaved roads and other sources as contributors to particulate pollution which were amenable to control. The agency next drafted regulations designed to provide the best control feasible for the fugitive dust sources that they had identified. However, due to lack of available data on (1) emission rates from these sources and (2) the effectiveness of the proposed regulations in reducing particulate emissions, the Commission was unable to quantitatively demonstrate that the fugitive dust controls would result in the necessary reduction in emissions.

To compound this problem of presentation, measured particulate levels at some sampling sites were increasing with time, rather than decreasing according to the projections of the initial implementation plan. This divergence of actual measurements from projections indicated that the emission inventory on which the control strategy was based did not account for all emission sources impacting on the samplers.

The present study was thus undertaken to quantify the reduction in fugitive dust emissions that can be expected from enforcement of the proposed regulations and to estimate the resulting air quality in three Colorado Air Quality Control Regions with these regulations in addition to existing control regulations.

The procedure employed to accomplish these objectives was first to prepare a detailed inventory of fugitive dust emissions by county for the three AQCR's; Metro-Denver, Pawnee and San Isabel. Concurrently, the inventory of conventional particulate emissions that was submitted in the implementation plan was updated. Next, the approximate control efficiency of the proposed fugitive dust regulations in reducing emissions from each source category was determined. Using the combined particulate inventory and estimated emission reductions, the expected air quality in the three AQCR's was then determined by the proportional modeling, or "rollback" method on a county basis. Finally, conclusions were drawn on the adequacy of the proposed and existing regulations and recommendations were made on particulate source categories in need of further control.

The fugitive dust emission inventory methodology is described in this report, and the updated and combined particulate inventory is presented. Also discussed are procedures for estimating control efficiencies of the proposed fugitive dust regulations. The rollback calculations are performed and summarized and recommendations for futher emission reductions are made.

Fugitive Dust Emission in the Three Air Quality Control Regions:

The list used in reporting fugitive dust emissions in this study was based upon reevaluation of the fugitive dust source categories as the inventory progressed. As a result of this review, three changes were made in the classifications:

1. a category was added -- dust from traffic on paved streets after the streets have been sanded for snow control;
2. unpaved parking lots were deleted from the inventory when preliminary data indicated that regional emissions would be negligible; and
3. the construction category was divided into two separate categories with different emission factors and data sources -- highway construction and residential, industrial, and commercial construction.

The revised listing at source categories, used in reporting fugitive dust emissions in this study is:

- unpaved roads
- sand on paved roads
- agriculture
- land development
- residential, industrial, and commercial construction
- highway construction
- quarrying, mining, and tailings
- aggregate storage
- cattle feedlots

The summary of emission estimating parameters and emission factors appear in Table 2.1 on the following page.

Table 2.1. SUMMARY OF EMISSION ESTIMATING PARAMETERS AND EMISSION FACTORS

COLORADO FUGITIVE DUST STUDY - 1972

Source Category	Source Parameters	Data Obtained From	Emission Factor Information	
			Emission Factor	Reference
Unpaved Roads	Vehicle Miles Traveled (VMT) = miles of unpaved road X average daily traffic	Colorado Dept. of Highways	3.7 lbs/vehicle mile	Investigation of Fugitive Dust-Sources, Emissions, and Control. Contract No. 68-02-0044, Task Order 9, by PEDCo-Environmental Specialists, Inc.
Sand on Paved Roads (Snow Control)	(VMT) X Number of days with sand	Denver Regional Traffic Council	.17 lbs/vehicle mile	The Measurement, Cost, and Control of Traffic Dust in Seattle's Duwamish Valley. AP-72-5. 1972
Agriculture	Soil Type Crop Type Acreage by Crop Type Climatic Conditions	Soil Conservation Service-U.S.Dept. of Agriculture Colorado Dept. of Agriculture Colorado Dept. of Agriculture Guide for Wind Erosion Control on Cropland (SCS)	E_s=(.025) IKCL'V',where E_s=suspended particulate fraction of wind erosion losses off tilled fields, tons/acre/year I =Soil erodibility, tons/acre/year K =Surface roughness factor, dimensionless C = Climatic factor, (dimensionless) L'=Unsheltered field width factor, dimensionless V'=Vegetative cover factor, dimensionless	Craig, D.G. and J.W. Turelle. Guide for Wind Erosion Control on Cropland in the Great Plains States. USDA, Soil Conservation Service. 1964.
Land Development	Acreage Developed	Colorado Land Use Commission	.0013C X tons/acre/yr. where C = the climatic factor, dimensionless	(PEDCo Task 9 Report)
Residential, Industrial, & Commercial Construction	Acreage under Construction	Denver Metro COG, County Engineers, County Assessor	.8 tons/acre/month of construction	(PEDCo Task 9 Report)
Highway Construction	Miles of Highway Under Construction	Colorado Dept. of Highways	1.12 tons/acre/month of construction	(PEDCo Task 9 Report)
Quarrying, Mining & Tailings	Acres of Tailings, Waste, and Storage	Colorado BOM	2.2 to 9.9 tons/acre/year depending on C, climatic factor	(PEDCo Task 9 Report)
Aggregate Storage	Tons of Aggregate Stored	Contact of Plant Operators	.005 tons/ton/yr. - sand .00079 tons/ton/yr. - gravel	(PEDCo Task 9 Report)
Cattle Feedlots	No. of Head of Cattle	EPA - Region VIII	1.9 to 7.3 tons/1000 head/year, depending on size of feed lot	(PEDCo Task 9 Report)

SUMMARY OF
FUGITIVE DUST EMISSION SOURCE PARAMETERS

TABLE 2.4 FUGITIVE DUST EMISSION SOURCE PARAMETERS
BY SOURCE CATEGORY AND COUNTY - 1972 - METRO
DENVER AQCR

Source Category	Source Parameter	Adams	Arapahoe	Boulder	Clear Creek	Denver	Douglas	Gilpin	Jefferson	Region Total
Unpaved roads	Vehicle miles per day	18,821	12,155	15,411	1,463	998	11,067	2,277	26,271	68,463
Sand on paved roads (snow control)	Vehicle miles per day	1,293,656	854,784	363,131	neg.	3,801,728	neg.	neg.	1,687,224	8,000,523
Agriculture	Total acreage[1] emitting fugitive dust	29,386	21,564	31,085	neg.	neg.	2,688	neg.	1,170	85,893
Land development	Acreage developed	1,231	5,000	1,430	300	Included with construction	13,304	50	2,420	23,735
Residential, Industrial, & commercial construction	Acreage under construction	854	845	78	600	197	176	100	950	3,600
Highway construction	Acres of highway under construction	99	33	31	230	32	neg.	neg.	197	622
Quarrying, mining & tailings	Acres of tailings, waste, and storage	40	52	109	635	0	41	5	132	1,014
Aggregate storage	Tons of aggregate stored	10,200	9,500	9,500	neg.	13,300	1,400	700	4,200	48,800
Cattle feedlots	Number of head of cattle on feed	41,050	neg.	30,000	neg.	neg.	4,750	neg.	neg.	75,800

1) Croplands from which insignificant amounts of dust were emitted are not included.

SUMMARY OF
FUGITIVE DUST EMISSION SOURCE PARAMETERS

TABLE 2.5 FUGITIVE DUST EMISSION SOURCE PARAMETERS BY SOURCE CATEGORY AND COUNTY - 1972 - PAWNEE AQCR

Source Category	Source Parameter	Larimer	Logan	Morgan	Phillips	Sedgwick	Washington	Weld	Yuma	Region Total
Unpaved roads	Vehicle miles per day	22,170	19,982	16,629	16,189	10,538	20,218	50,246	19,982	175,954
Sand on paved roads (snow control)	Vehicle miles per day	neg.	neg.	neg.	neg.	neg.	neg.	211,253	neg.	211,253
Agriculture	Total acreage emitting fugitive dust	72,232	78,775	121,310	152,839	110,700	61,080	358,803	103,788	1,059,527
Land development	Acreage developed	1,823	neg.	neg.	neg.	neg.	neg.	1,003	neg.	2,826
Residential, Industrial, & commercial construction	Acreage under construction	1,972	100	neg.	neg.	neg.	neg.	400	neg.	2,472
Highway construction	Acres of highway under construction	46	9	neg.	neg.	neg.	neg.	56	neg.	111
Quarry, mining & tailings	Acres of tailings, waste, and storage	315	1	2	0	0	0	11	0	329
Aggregate storage	tons of aggregate stored	10,200	2,800	700	700	700	700	4,900	1,400	22,100
Cattle feedlots	Number of head of catle on feed	32,750	107,500	128,000	8,900	7,500	7,000	417,500	35,750	744,900

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(1) Croplands from which insignificant amounts of dust were emitted are not included.

SUMMARY OF
FUGITIVE DUST EMISSION SOURCE PARAMETERS

TABLE 2.6 FUGITIVE DUST EMISSION SOURCE PARAMETERS
BY SOURCE CATEGORY AND COUNTY - 1972 -
SAN ISABEL AQCR

Source Category	Source Parameter	Chaffee	Custer	El Paso	Fremont	Huerfano	Lake	Las Animas	Park	Pueblo	Teller	Region Total
Unpaved Roads	Vehicle Miles Per Day	5,505	4,199	59,690	7,871	3,738	1,480	12,840	247	10,040	8,307	113,917
Sand on Paved Roads (Snow Control)	Vehicle Miles Per Day	Neg.	Neg.	1,008,000	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	1,008,000
Agriculture	Total Acreage[1] Emitting Fugitive Dust	14,312	3,449	55,671	8,529	9,935	Neg.	12,069	79	26,387	Neg.	130,431
Land Development	Acreage Developed	70	21,793	33,203	5,671	19,702	Neg.	1,038	10,565	11,155	2,080	105,277
Residential, Industrial, & Commercial Construction	Acreage Under Construction	Neg.	200	Neg.	Neg.	500	Neg.	400	Neg.	2,200	Neg.	3,300
Highway Construction	Acres of Highway Under Construction	26	Neg.	Neg.	28	Neg.	Neg.	12	Neg.	88	Neg.	154
Quarrying, Mining & Tailings	Acres of Tailings, Waste & Storage	40	1	0	126	0	1,330	17	4	13	2	1,533
Aggregate Storage	Tons of Aggregate Stored	700	Neg.	Neg.	2,800	Neg.	700	700	700	Neg.	4,200	9,800
Cattle Feedlots	Number of Head of Cattle on Feed	Neg.	Neg.	550	Neg.	Neg.	Neg.	Neg.	Neg.	13,500	Neg.	14,050

(1) Croplands from which insignificant amounts of dust were emitted are not included.

SUMMARY OF THE COLORADO EMISSION INVENTORY FOR PARTICULATE MATTER FROM ALL SIGNIFICANT SOURCES, BY REGIONS

Table 3.1 COLORADO EMISSION INVENTORY - PARTICULATES ONLY
FUGITIVE DUST PROJECT (TONS PER YEAR)

METRO-DENVER - AQCR

Source Category/County	ADAMS	ARAPAHOE	BOULDER	CLEAR CREEK	DENVER	DOUGLAS	GILPIN	JEFFERSON	TOTAL
AREA SOURCES: Miscellaneous	1	0	1	neg.	neg.	neg.	neg.	neg.	2
Fuel Combustion	158	161	129	neg.	397	3	neg.	177	1,025
Process Losses	596	126	224	neg.	649	1	neg.	106	1,702
Solid Waste Disposal	501	3	3	26	134	6	6	4	683
Transportation	853	573	406	13	2,707	42	3	730	5,327
Total Area Sources	2,109	863	763	39	3,887	52	9	1,017	8,739
POINT SOURCES	12,448	8,537	7,882	neg.	1,117	1,444	2,640	8,652	42,720
FUGITIVE DUST SOURCES									
Unpaved Roads	12,704	8,205	10,403	987	674	1,537	17,732	7,470	59,712
Sand on Paved Roads (Snow Control)	1,979	1,307	555	neg.	5,816	neg.	neg.	2,581	12,238
Agriculture	6,358	821	6,586	neg.	neg.	580	neg.	328	14,673
Land Development	240	975	278	20	neg.	2,595	3	473	4,584
Residential and Commercial Construction	2,883	3,005	285	1,920	944	563	480	3,235	13,315
Highway Construction	1,266	359	490	3,091	524	neg.	neg.	2,648	8,378
Quarrying, Mining, and Tailings	320	416	1,351	1,419	neg.	328	11	1,056	4,901
Aggregate Storage	164	24	124	neg.	80	4	2	11	369
Cattle Feedlots	144	neg.	105	neg.	neg.	22	neg.	neg.	271
Fugitive Dust Total	26,058	15,112	20,177	7,437	8,018	5,629	18,228	17,802	118,461
GRAND TOTAL	40,615	24,512	28,822	7,476	13,022	7,125	20,877	27,471	169,920

SUMMARY OF THE COLORADO EMISSION INVENTORY FOR PARTICULATE MATTER FROM ALL SIGNIFICANT SOURCES, BY REGIONS

Table 3.2 COLORADO EMISSION INVENTORY - PARTICULATES ONLY
FUGITIVE DUST PROJECT (TONS PER YEAR)

PAWNEE - AQCR

Source Category/County	LARIMER	LOGAN	MORGAN	PHILLIPS	SEDGWICK	WASHINGTON	WELD	YUMA	TOTALS
AREA SOURCES: Miscellaneous	19	1	6	neg.	neg.	1	4	neg.	31
Fuel Combustion	738	37	23	neg.	26	neg.	1,290	3	2,117
Process Losses	231	9	49	16	neg.	10	106	14	435
Solid Waste Disposal	28	99	106	21	18	29	4	45	350
Transportation	455	81	126	12	10	16	521	25	1,246
Total Area Sources	1,471	227	310	49	54	56	1,925	87	4,179
POINT SOURCES	2,066	320	207	neg.	88	neg.	5,443	neg.	8,129
FUGITIVE DUST SOURCES									
Unpaved Roads	14,965	13,488	11,224	10,928	7,114	13,647	33,916	13,488	113,770
Sand on Paved Roads (Snow Control)	neg.	neg.	neg.	neg.	neg.	neg.	318	neg.	318
Agriculture	15,551	17,023	3,116	21,633	16,852	8,451	77,295	40,444	200,365
Land Development	355	neg.	neg.	neg.	neg.	neg.	195	neg.	550
Residential and Commercial Construction	1,577	480	neg.	neg.	neg.	neg.	1,280	neg.	3,337
Highway Construction	645	90	neg.	neg.	255	neg.	725	neg.	1,715
Quarrying, Mining, and Tailings	2,520	8	16	neg.	neg.	neg.	88	neg.	2,632
Aggregate Storage	26	7	2	2	2	2	2	13	56
Cattle Feedlots	115	204	243	41	35	32	793	125	1,538
Fugitive Dust Total	35,754	31,300	14,601	32,604	24,258	22,132	114,612	54,070	329,331
GRAND TOTAL	39,291	31,847	15,118	32,653	24,400	22,188	121,985	54,157	341,639

SUMMARY OF THE COLORADO EMISSION INVENTORY FOR PARTICULATE MATTER FROM ALL SIGNIFICANT SOURCES, BY REGIONS

Table 3.3 COLORADO EMISSION INVENTORY - PARTICULATES ONLY
FUGITIVE DUST PROJECT (TONS PER YEAR)

SAN ISABEL - AQCR

Source Category/County	CHAFFEE	CUSTER	EL PASO	FREMONT	HUERFANO	LAKE	LAS ANIMAS	PARK	PUEBLO	TELLER	TOTAL
AREA SOURCES:											
Miscellaneous	380	128	30	1	100	95	1	-	2	-	737
Fuel Combustion	2	neg.	131	9	neg.	10	7	neg.	131	neg.	290
Process Losses	19	neg.	74	57	8	4	9	8	34	9	222
Solid Waste Disposal	60	26	8	173	43	57	34	43	61	20	525
Transportation	neg.	neg.	354	24	neg.	neg.	18	neg.	156	neg.	552
Total Area Sources	461	154	597	264	151	166	69	51	384	29	2,326
POINT SOURCES	neg.	neg.	2,430	18,046	13	8,541	78	6	13,076	neg.	42,190
FUGITIVE DUST SOURCES											
Unpaved Roads	3,716	2,834	40,290	5,313	2,523	999	8,667	167	6,777	5,607	76,893
Sand on Paved Roads (Snow Control)	neg.	neg.	1,541	neg.	neg.	neg.	neg.	neg.	neg.	neg.	1,541
Agriculture	3,981	1,457	16,721	1,353	694	neg.	1,633	24	4,938	neg.	30,801
Land Development	5	4,250	6,475	1,105	5,123	neg.	303	1,718	2,175	405	21,559
Residential and Commercial Construction	neg.	960	neg.	neg.	neg.	neg.	1,920	neg.	19,840	neg.	22,720
Highway Construction	174	neg.	neg.	242	neg.	neg.	81	neg.	1,317	neg.	1,814
Quarrying, Mining, and Tailings	110	8	neg.	neg.	neg.	2,970	207	290	104	16	3,705
Aggregate Storage	2	neg.	neg.	7	neg.	2	2	neg.	41	neg.	54
Cattle Feedlots	neg.	neg.	4	neg.	neg.	neg.	neg.	47	neg.	neg.	51
Fugitive Dust Total	7,988	9,509	65,031	8,020	8,340	3,971	12,813	2,246	35,192	6,028	159,138
GRAND TOTAL	8,449	9,663	68,058	26,330	8,504	12,678	12,960	2,303	48,652	6,057	203,654

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PREDICTED EMISSION REDUCTIONS

Table 4.1

CONTROL EFFICIENCIES FOR FUGITIVE DUST REGULATIONS

SOURCE CATEGORY	REGULATION	CONTROL METHOD	ESTIMATED EFFICIENCY	EXISTING EFFICIENCY
Unpaved roads	1.II.D.2 and II.D.3; roads with > 30 veh./hr* must be controlled by approved method	Paving Stabilization Closure or detouring Speed control Frequent watering	85 % 50 % 60 % 25 % 50 % Should be able to attain 60 % reduction on those roads with > 30 veh./hr	0
Sand on paved roads	None	Quicker pickup of sand, but cannot conflict with road safety	(25 %)**	0
Agriculture	1.II.D.5; no added restrictions beyond Colo. Dept. of Ag. soil conservation measures	Mulch or stubble plowing Winter cover crops Stripcropping	10 %	10 %
Land development	Question the enforceability of II.D.1	Delay of roadway construction Control plan for any regrading	(Directly proportional to reduced roadway mileage)** (80 %)**	0
Residential and commercial construction	1.II.D.1 (must submit control plan if cited), plus special considerations for construction	See page 11 of regulations	50 %	0
Highway construction	1.II.D.1, plus must follow State Guidelines for Road and Bridge Const. and contract terms	See page 11 of regulations	50 %	20 %
Quarrying, mining, and tailings	1.II.D.1, plus Colo. Bureau of Mines permit system; also, special considerations for mining and cement ind.	Enclose transfer operations Control tailings Pave haul roads Treat stockpiles Revegetation and surface compaction	80 % 80 % 85 % 50 % 65 % Weighted average of 75 %	0
Aggregate storage	1II.D.1	Chemical dust palliatives Watering	50 %	0
Cattle feedlots	1II.D.1	Watering	80 %	Major = 80 % Large = 55 % Med. = 42 % Small = 10 %

*Higher required traffic volumes for road segments less than 1/2 mile

**Not included in emission reduction calculations because of questionable enforceability

Predicted Particulate Air Quality by County:

The procedure used to estimate ambient air quality was the proportional model, or "rollback," in the following form:

$$\frac{A_2 - B}{A_1 - B} = \frac{E_2}{E_1}, \quad \text{where}$$

A_1 = Existing air quality at location in county having highest measured concentration

A_2 = projected air quality

B = background concentration

E_1 = existing particulate emissions in county

E_2 = projected particulate emissions in county after implementation of regulations

To determine the reduction needed to reach the air quality standard, the appropriate value for the standard was substituted for A_2.

The proportional modeling was performed separately for each county rather than for entire AQCR's since this procedure; (1) provided some definition of the distribution of particulate air quality throughout the relatively large AQCR's and (2) permitted a better evaluation of the sources which need additional control in the "hot spots."

Air quality data and summaries for 1972 for every hi-vol site in Colorado were obtained from the National Aerometric Data Bank through Region VIII of the Environmental Protection Agency. The data were analyzed to find the maximum annual geometric mean and maximum 24-hour reading recorded in each county. The annual mean and maximum 24-hour reading did not necessarily come from the same sampling station in the county.

These two values for each county are presented by AQCR in Tables 5.1, 5.2, and 5.3. Using the proportional model and the annual geometric means, the percent reductions in emissions in each county that are needed to meet the primary and secondary air quality standards were calculated and are recorded in the same tables. The annual mean has been used in the rollback calculations in every case, even though a higher reduction was sometimes shown to be necessary when the maximum single reading was used, for the following reasons:

1. the validity of the single high readings is much more questionable than long-term averages and thus they provide a much weaker base for the development of control strategies;

2. the 24-hour air quality standard could be interpreted to be for the second highest reading during the year --"maximum 24-hour concentration not to be exceeded more than once per year";

3. most high values could be systematically disqualified due to the presence of high winds, episode conditions, nonrecurring emissions near the site, or other reasons; and

4. the variation in maximum recorded values is much greater from year to year, and therefore they are not a good indicator of overall air quality at a site.

Readings at the sites in different topographic areas of the state with the lowest annual geometric means were used to estimate the particulate background concentrations for the proportional model. Values of 35 micrograms per cubic meter on the plains, 15 micrograms per cubic meter in the mountains, and 30 micrograms per cubic meter in the sandhills at the northeastern corner of the State were selected.

The predicted particulate air qualities in all counties with existing air quality data are shown in Tables 5.1 through 5.3. The emission totals utilized in calculating the ambient levels are also presented. The results indicate that the primary standards will be exceeded by significant amounts in all three AQCR's, even after implementation of the proposed fugitive dust regulations.

In general, the inadequate reductions in emissions can be attributed to the low control efficiencies of fugitive dust control regulations and their large share of total particulate emissions. For example, county-wide emission reductions by county range from 19 to 45 percent in the Metropolitan Denver AQCR and from only 2 to 15 percent in the Pawnee AQCR.

The presence of extremely high particulate levels currently in Denver County makes achievement of air quality standards by 1975 a very remote possibility. While the projected air quality levels in all parts of the three regions are much higher when fugitive dust is considered, they appear to correspond much better when fugitive dust is considered, they appear to correspond much better with actual particulate air quality trends than the control strategy evaluations of the initial implementation plan, which did not consider fugitive dust.

Summary and Recommendations:

The initial purpose of this study was to quantitatively evaluate the adequacy of proposed fugitive dust control regulations in achieving secondary particulate air quality standards for three AQCR's in Colorado. However, the analyses that were performed, including an emission inventory that considered fugitive dust emissions, indicated that attainment of the secondary standard for particulate matter in semiarid regions may be impossible to achieve because of the combination of sparse vegetation, low rainfall and wind.

The emission inventory showed that unpaved roads were the largest source of particulate, with agriculture being the second largest. In the three AQCR's combined, these two sources accounted for 36 and 34 percent, respectively, of the particulate emissions inventoried. The other seven fugitive dust categories -- sanded paved roads (for snow control), land development, building construction, highway construction, quarrying/mining, aggregate storage, and cattle feedlots -- also contributed significant emissions on a regional basis, so that fugitive dust was responsible for 70 percent of particulate emissions in the Metro-Denver AQCR, 97 percent in Pawnee AQCR, and 78 percent in San Isabel AQCR.

Several available control methods were identified, either in the proposed regulations or in published reports on fugitive dust control, for each source category except agriculture. Average control efficiencies of 25 to 85 percent were assigned to these methods for purposes of estimating the effect of the proposed regulations in reducing emissions and improving air quality.

The effect of the emission reductions on particulate air quality was determined by use of the proportional model for each county where high volumn air sampler data was available. These calculations indicated that Denver County would still have a minimum particulate level of 130 ug/m3 annual geometric mean after implementation of the proposed regulations, and that the counties surrounding Denver would generally have maximum levels near the primary standard of 75 ug/m^3. In the Pawnee AQCR, with its extensive farming areas, all counties with hi-vol data were shown to have projected air qualities at or above 75 ug/m^3, with 88 ug/m^3 in Weld County being the highest projected concentration. In the San Isabel AQCR, both Pueblo and El Paso (Colorado Springs area) counties had projected air qualities above the primary standard, at 77 and 91 ug/m^3, respectively.

Existing Colorado control regulations for particulate emissions from fuel combustion, processes, and other sources were reviewed to determine whether additional emission reductions could be obtained from these sources. Generally, it was concluded that these regulations represent the best available technology, and no significant improvements could be expected over these allowable emission rates.

Three recommendations were made in an effort to increase the emission reductions attributable to the proposed fugitive dust regulations:

1. control plans should be required for all road seqments with traffic densities greater than 20 vehicles/hour, instead of the proposed 30 vehicles/hour on road segments greater than one-half mile long;

2. the requirements for submitting a control plan should be modified to insure that all land developments with unpaved roads must submit a plan, and

3. a program should be instituted for the more rapid and more complete removal of sand from streets and highways following its application for snow control.

However, even with these additional provisions, it is still doubtful that the secondary standards will be achieved in the three AQCR's. The major problems in achieving the standards are the large contribution of fugitive dust to total particulate emissions in the regions and the low control efficiencies attainable for most fugitive dust sources.

(End of PEDCo Report Summary)

Adopted: March 14, 1974
Effective: August 1, 1974

Repeal and Reenactment
of Section II.D
Regulation No. 1

Emission Control Regulations for Particulates, Smokes, and Sulfur Oxides for the State of Colorado

II. PARTICULATE EMISSION REGULATIONS -

D. Fugitive Dust:

1. Effective Date and Affected Areas.

   a. The existing Section II.D. of Regulation No. 1 controlling fugitive dust shall be repealed effective July 31, 1974 and the new Section II.D as follows shall become effective August 1, 1974. This delayed effective date for the new Section II.D allows time for voluntary compliance with the new provisions.

   b. Sections II.D.3, 4 and 5 shall apply only to Commission designated air pollution control areas as shown on page 1.13 of this Regulation No. 1.

   c. Sections II.D.2, 6, 7, 8, and 9 shall apply statewide.

2. Opacity Regulations for Fugitive Dust Emissions Emanating from Unenclosed Operations.

   a. No person shall emit or cause to be emitted from any source of fugitive dust whatsoever, any particulate matter which,

      (i) at or from the source of said emission, is of such a shade or density on the property of emission origination so as to obscure an observer's vision to a degree in excess of 20% opacity, or

      (ii) is visibly transported off the property of emission origination and remains visible to an observer positioned off said property when sighting along a line which does not cross the property of emission origination.

b. Exceptions from Opacity Regulation Section II.D.2(a).

(i) All unpaved roads and unpaved parking lots (covered by Section II.D.3).

(ii) Earth and construction-material moving and excavating activities except for crushing, grinding, milling, conveying, and bagging processes. (covered by Section II.D.4).

(iii) Demolition, wrecking, and moving of structures and explosives detonation activities. (covered by Section II.D.5).

(iv) Open mining activities. (covered by Section II.D.6).

(v) Agricultural cultivation activities (regulated in part by Section II.D.7).

(vi) Sources of fugitive dust which exceed opacity regulations for a period or periods aggregating less than three (3) minutes in any sixty (60) consecutive minutes.

(vii) Sources of fugitive dust from which dust emissions exceed opacity regulations when wind velocities exceed 30 m.p.h. as determined by one or more of the following practices as approved by the Division: By a one-hour average at the nearest official station of the U.S. Weather Service; by interpretation of surface weather maps by a qualified meteorologist; or by use of one or more anemometers at the site.

(viii) any other sources as specified by the Commission.

3. Unpaved Roads and Unpaved Parking Areas.

a. All new unpaved roads and unpaved parking areas:

a-1 No person shall construct or operate a new unpaved road, or new unpaved parking area unless a permit therefore has been granted by the Division pursuant to Section II.D.8.

a-2 Exceptions:

(i) Any new road or parking area which, after demonstration to the Division, will not exceed an average daily traffic count of 165 vehicles averaged over any consecutive 3-day period.

(ii) Any new road or parking area associated solely with housing or apartment projects of seven family dwelling units or less.

(iii) Any new road or parking area to be hard surfaced (concrete or bituminous binder and rock) within six (6) months of start of construction, except that the person constructing or contracting to construct said road or parking area shall notify the Division in advance of commencing construction of the nature, size, and location of the hard surfacing project and the dates on which the road or parking area construction project is to start and is to be completed. The person shall use abatement and preventive measures as outlined in II.D.9 during construction.

a-3 The Division may require the person owning or maintaining any new or existing unpaved road to supply traffic count information on a regular basis to the Division as necessary to determine if additional abatement and preventive measures or changes in the implementation time schedule are required of the person by the Division.

b. Existing Privately Owned or Maintained Unpaved Roads and Unpaved Parking Areas.

b-1 Any person owning any unpaved road or unpaved parking area or having a right-of-way easement or possessory right to use the same, found by the Division to exceed a maximum allowable traffic count of 165 vehicles per day averaged over any consecutive 3-day period, shall discontinue and prevent use of that road or parking area, unless the Division has approved a fugitive dust control plan which includes preventive measures as outlined in II.D.9 and unless the conditions of the approved plan are met continually.

c. Existing Publicly Owned or Maintained Unpaved Roads and Unpaved Parking Areas.

c-1 By July 1 of each year the Division shall submit to the political subdivision owning or maintaining unpaved roads or unpaved parking areas and to the Commission, a report on the nature and degree of the emissions from existing unpaved roads and unpaved parking areas within said political subdivisions which exceed 165 vehicles per day averaged over any 3-day period based upon traffic count information as collected by the Division or the political subdivision.

c-2 Said political subdivisions shall submit a plan and progress report to the Division by October 1 of each year which includes a specified time schedule for the control of fugitive dust emissions on unpaved roads and unpaved parking areas as reported by the Division pursuant to Section II.D. 3(c-1). Said plans shall be based upon:

(i) availability of existing and new funds for paving or fugitive dust suppression;

(ii) use of preventive measures applicable to unpaved roads and unpaved parking areas as outlined in Section II.D.9.

4. Earth and Construction-Material Moving and Excavating except for Crushing, Grinding, Milling, Conveying and Bagging Processes.

No land developer of a new, or owner of an existing construction or land development project shall throughout the duration of the project, disturb or contract to disturb by grading, excavating or depositing on more total surface area than five (5) acres of land (in the aggregate) unless abatement and preventive measures as outlined in Section II.D.9 are being met continually. New sources regulated in this paragraph 4 must be granted a permit from the Division pursuant to Section II.D.8 prior to breaking ground.

5. Demolition, Wrecking and Moving of Structures and Explosives Detonation Activities.

a. No person shall conduct demolition, wrecking, or moving of structures or explosives detonation activities unless a permit therefore has been granted by the Division pursuant to Section II.D.8 and unless the provisions of Section II.D.9 are being met continually.

6. Open Mining Activities:

No developer of a new or owner of an existing open mining activity shall throughout the duration of the operation, disturb or contract to disturb by grading, excavating, or depositing on more total surface area than one (1) acre of land (in the aggregate) unless the provisions of Section II.D.9 are being met continually. New open mining activities must be granted a permit from the Division pursuant to Section II.D.8 prior to operation. Open mining shall be as defined in the Colorado Open Mining Land Reclamation Act of 1973 meaning the mining of natural mineral deposits of limestone used for construction purposes, coal, sand, gravel, and quarry aggregate, by removing the overburden lying above such deposits and mining directly from the deposits thereby exposed. The term includes, but is not limited to, such practices as open cut mining, open pit mining, strip mining, quarrying, and dredging.

7. Complaint Section:

When a complaint of dust or fugitive dust is registered with the Division by a single complainant or multiple complainants who allege that any dust or fugitive dust obstructs or interferes with the reasonable and comfortable use of his or their property, the Division shall investigate and if the Division finds that such conditions exist, the Division shall issue a citation to the person or persons from whose land or activity the objectionable emission emanates and shall require a fugitive dust control plan containing reasonable control measures where appropriate according to the abatement and preventive measures as outlined in Section II.D.9.

8. New Source Permit Requirements:

a. No permit shall be granted to an applicant unless the Division determines to its satisfaction that a plan has been submitted on forms provided by the Division which includes the following information:

a-1 A description of the nature and scope of the activity and of the existing or new sources of fugitive dust including but not limited to the following:

excavating
land leveling
repair or alteration
sand blasting
vehicle movement
screening
drying
waste disposal
detonation of explosives
earth moving
construction
demolition
handling
transporting
mining activities
crushing
site preparation
feed lots
campgrounds
fairgrounds
processing of sand, gravel and rock
cleaning
mixing
miscellaneous uses of land
storage
quarrying
unpaved roads
unpaved parking areas

a-2 Fugitive dust abatement and preventive measures as outlined in Section II.D.9.

a-3 A time schedule for fugitive dust abatement and prevention.

a-4 A description of any monitoring or sampling methods used for recording and reporting data to the Division.

b. The permit may be granted and renewed for any period of time as deemed appropriate by the Division.

c. The permit may be granted to any single applicant for any single project or combination of projects as deemed appropriate by the Division.

d. In the granting of a permit, the Division may impose any permit condition it deems necessary to attain and maintain compliance with the provisions of this Section II.D.

e. The Division may suspend, revoke, modify, or refuse to renew or grant a permit under the following conditions:

(i) the requirements of this Section II.D. have not been met;

(ii) the approved compliance or prevention plan has not been followed as determined by the Division, or

(iii) the permit conditions are not met.

f. Any appeal by an applicant of a denial or revocation of a permit shall be conducted in accordance with the provisions of Sections 66-31-12(4)(f), (g), and (h) of the Act.

9. List of Abatement and Preventive Measures.

a. Unpaved Roads and Unpaved Parking Areas.

a-1 Abatement and preventive measures shall be approved by the Division and may include but shall not be limited to frequent watering, addition of dust palliatives, detouring, paving, closure, speed control, or other means such as surface treatment with penetration chemicals (ligninsulfonates, oil, water, cutbacks, etc.) or methods of equal or greater effectiveness in reducing the air contamination produced.

b. Demolition, Wrecking and Explosive Detonation Activities; Earth and Construction Material Moving, Mining and Excavation Activities.

b-1 Abatement and preventive fugitive dust control measures shall be approved by the Division and may include, but shall not be limited to:

- wetting down, including pre-watering;
- landscaping and replanting with native vegetation;
- covering, shielding or enclosing the area;
- paving, temporary or permanent;
- treating, the use of dust palliatives and chemical stabilization;
- detouring;
- restriction of the speed of vehicles on sites;
- prevention of the deposit of dirt and mud on improved streets and roads and other such effective means of dust control as the Division may deem necessary;
- disturbing less topsoil and reclaiming as soon as possible.

b-2 Sequential blasting shall be employed whenever or wherever feasible to reduce the amounts of unconfined particulate matter;

b-3 Such dust control strategies as re-vegetation, delay of surface opening until demanded, or surface compaction and sealing, shall be applied.

b-4 Haulage equipment shall be washed or wetted down, treated, or covered when necessary to minimize the amount of dust emitted in transit and in loading.

b-5 These measures shall also be enforced during periods when actual construction work is not being conducted, such as on weekends and holidays.

NOTE: THE FOLLOWING DEFINITIONS ARE TO BE ADDED TO THE COMMON PROVISIONS REGULATIONS, SECTION I, ENTITLED, "DEFINITIONS."

Adopted : March 14, 1974
Effective Date: August 1, 1974

AMENDMENT
TO
COMMON PROVISIONS REGULATIONS

I. DEFINITIONS:

FUGITIVE DUST - Solid airborne particulate matter emitted from any source other than [an opening which channels the flow or air contaminants and then exhausts the contaminants directly into the atmosphere.] Fugitive dust also includes solid particles released into the atmosphere by natural forces or by mechanical processes such as crushing, grinding, milling, drilling, demolishing, shoveling, conveying, covering, bagging, sweeping, etc.

LAND DEVELOPER - Any person, firm, corporation or governmental entity who initiates any change in the state of existing land use. The person, firm, corporation or governmental entity who contracts with others for construction services for said change in land use will be deemed to be the land developer.

(DELETE FROM COMMON PROVISIONS REGULATION - DEFINITION OF DUST)

ADD TO PAGE 12 OF REGULATION NO. 1:

I.A. Stationary Air Contamination Sources

2. Exceptions:

(e) THE PROVISIONS OF I.A.I. SHALL NOT APPLY TO FUGITIVE DUST.

Impractical Constraints in Meeting Federal Secondary Ambient Air Quality Standards for Particulate Matter:

The Commission agrees with the E.P.A. Consultant, PEDCo, on the impracticality of meeting secondary standards as a result of the unique semiarid conditions of much of Colorado and the Southwest. In fact, the Federal secondary particulate standard of 150 ug/m^3 is exceeded on almost completely virgin (undeveloped) areas. For example, at the Sand Dunes National Monument, 208 ug/m^3 for a 24-hour average was recorded March 26, 1973 and 628 for Alamosa, Colorado on the University grounds. Loren Crow, a professional meteorologist, has testified before the Commission, that based upon data collected by him, this undeveloped area particulate problem exists for much of the Front Range area. He cited documented readings of over 300 ug/m^3 for 24-hour periods on windy days east of Pueblo, Colorado on agricultural lands unaffected by other sources.

It seems that high winds in these semiarid areas take advantage of the sparse vegetation and the ground literally becomes airborne - a condition beyond human control and one not adequately recognized by Federal air pollution control laws. Therefore, we recommend to E.P.A. that when wind speeds exceed 30 m.p.h. those situations be exempt from meeting the secondary particulate matter standard. We concur with the use of annual geometric mean data as a more reasonable basis for a control plan; but nevertheless, feel meeting the Federal Secondary Standard will have a devastating effect upon the State.

PEDCo stated before the Commission it has reviewed most of the fugitive dust control regulations in the U.S., and that those proposed by our Commission are the most restrictive. Surely this must indicate the intent of our Commission to do everything possible to control particulate matter emissions as long as a balance is maintained with other needs of our society.

With respect to any significant air pollution source, the Commission has regulations prohibiting new construction unless the Division determines to its satisfaction that:

a. The new air contamination source is so designed and will be constructed or modified to operate without causing a violation of the emission control regulations of the Commission, and any applicable national or local air pollution emission control ordinances and regulations.

b. The new air contamination source is designed, built, and equipped in accordance with the best available practical methods to reduce, prevent and control air pollution.

c. The new air contamination source, as designed or modified does not significantly endanger maintenance or attainment as determined by criteria set forth in IV.C.2 of any ambient air quality standards of the Commission, and any more stringent national or local ambient air quality standards.

With these regulatory measures, significant sources of particulate matter air pollution are not allowed to construct in Colorado. Existing sources perhaps face the most stringent fugitive dust control measures anywhere.

PEDCo has suggested that attaining the secondary standard is not possible in much of Colorado without closing down many existing activities. The Commission believes that in order to meet the secondary standard, a drastic measure as closing down much of Colorado's economy would be necessary. The Commission thinks such a measure is not realistic, especially when considering that the secondary standard is not based upon protecting human health.

Beyond the provisions of this plan an additional 21% or 5,000 tons/yr. of particulate matter control would be needed to meet the secondary standard for the Denver AQCR. For the Pawnee AQCR the figures are 20% or 24,500 tons/yr. and for the San Isabel AQCR, 14% or 9,500 tons/yr. Following is a statement of the social, economic and other problems associated with achieving the standards, which the Commission feels outweigh the air pollution benefits that would otherwise accrue.

Unpaved Roads:

Unpaved roads are not a problem in Denver City- County, but for all problem areas the Commission has adopted the following measures:

1. dust control of all roads in new developments and all new parking lots of over 165 vehicles per day traffic.

2. paving of existing roads under a plan and time schedule prepared by County and City authorities with maximum available funds for that purpose, the plans to be approved by our Division, and

3. maximum traffic counts to serve as a guide in determing paving priorities.

Road paving is expensive, amounting to about $20,000 a mile for minimum width two-lane roads. Much testimony has been collected by the Commission on the limitation of highway user funds and other revenues to pave the thousands of miles of roads in Colorado air basins. The Commission's plan calls for maximum possible paving with available funds. The Commission also recognizes increasing difficulty to acquire asphalt for paving with the increasing energy crisis.

Sand on Paved Roads:

The Commission seriously doubts the PEDCo recommendation that a 25% reduction of emissions is possible by picking up sand sooner. The State Department of Highways and Denver County Department of Highways have informed our Division that, in their opinion:

1. The sands used are 1/4 inch diameter material on down in size, to very fine material,

2. the sands are mostly comprised of river-run material and decomposed granite and that,

3. road crews are removing sand off the streets as soon as possible now without endangering the flow of traffic.

Assuming this information to be correct, eliminating or significantly reducing street sanding would appear to risk human injury and cause property damage problems, out of proportion to the air pollution benefits.

Agriculture:

Commission regulations require good conservation practices which save soil and prevent air pollution. Information has not been submitted to the Commission as to any practical controls available. Agriculture is a primary industry of Colorado. Though serious food shortages have not been felt by this country, surplus is declining. Agricultural and forest lands are decreasing in this nation at the rate of over one million acres per year, while our population continues to grow. Some critics warn that agricultural technology may not be keeping pace. We need food and clean air, and the Commission maintains it is doing everything reasonably possible to control agricultural air pollution sources.

Land Development and Construction Activities:

The regulations of the Commission require, on a case-by-case basis, review of all development plans of over 5 acres in the critical air pollution areas. Additionally, the Commission will consider smaller increments of road cutting, and requirements for road surfacing, and revegetation and surface treatment. Watering for dust suppression will be required where water is avilable. Inherently, earth-moving activities are dusty; especially where subsurface moisture content is low as in much of the Southwest United States. Control beyond that adopted by the Commission would most likely severely inhibit land development and construction activities, an alternative having serious economic implications. It is our intent to deny permits only to those development and construction plans which fail to employ all available practical air pollution controls as provided from time to time in Commission regulations and policy.

Quarrying Mining, Tailings and Aggregate Storage:

Going beyond the Commission and PEDCo recommendations, with possible minor exceptions, involves prohibiting the activity or causing severe economic hardship. Blasting cannot be totally controlled; nor can airborne particulate matter be controlled due to high winds. The Commission requires serial blasting under controlled conditions, wind barriers such as the use of berms and wind fences, and periodic watering as reasonable measures.

SULFUR OXIDES

Plan Requirements and Summary of Air Quality Data:

The Federal Register, Vol. 38, No. 178 - September 14, 1973, sets forth the revised secondary ambient air standard for sulfur dioxide. The amendments revoke the annual National Secondary Ambient Air Quality Standard for sulfur dioxide which is 60 micrograms per cubic meter (0.02 ppm). In addition, the amendments delete the maximum 24-hour concentration of 260 micrograms per cubic meter (0.1 ppm). The secondary 3-hour standard, a maximum concentration of 1300 micrograms per cubic meter (0.5 ppm) not to be exceeded more than once per year, remains in effect.

In the Denver Air Quality Control Region, sulfur dioxide as measured at the CAMP station since January, 1969, has not exceeded 0.30 ppm in any 3-hour average - well below the secondary 3-hour standard.

The only other region with any potential for sulfur dioxide concentrations is the Four Corners Region. Estimations for concentrations reaching Colorado from the power plants in New Mexico (23 miles from the Colorado border) were made for the State Implementation Plan using a point source model - a procedure permitted for use in Priority 1-A regions. The max9imum 1-hour concentration computed out as 279 micrograms per cubic meter (0.11 ppm). Thus the maximum 3-hour value would be less than 0.11 ppm and well below the secondary 3-hour standard of 0,5 ppm.

In short, a plan for meeting the secondary standard for sulfur oxides is not needed because the standards are not exceeded in Colorado. The Commission's existing regulations are deemed adequate to maintain the standards over the foreseeable future.

APPENDIX G

PROJECTION OF POINT SOURCE PARTICULATE EMISSIONS

The majority of particulate emissions from point sources in the Denver AQMSA occur within the Joint Regional Planning Program (JRPP) designated super districts. Therefore, most careful attention is paid to the projection of particulate emissions within this area while more rural regions are projected only after considering the results of the more extensive analysis of the super districts.

Due to the fact that different source sectors produce varying amounts of particulates in the various super districts and that these source sectors are assumed to grow at different rates within each super district, it is necessary to provide a weighting to each super district within each county. The point source sectors chosen for consideration are commercial-institutional (C-I) and industrial. The allocation scheme for each super district is then based on the amount of C-I employment and industrial employment within each super district. For the purpose of this study, the distribution of these parameters is considered not to have changed significantly between 1970, the last census presented in the Denver Regional Council of Governments (DRCOG) data; and 1972, the year of the National Emissions Data System (NEDS) emissions inventory. The 1970-based employment figures for each super district (SD) are given in Table G-1. The C-I employment is the "total employment" minus the "mfg., trnsp., commn., util. (mtcu)" which was considered to be the employment by industry.

Table G-1. EMPLOYMENT IN THE SUPER DISTRICTS (1970)[a]

County	Area	C-I	Total	Industrial	Total
Denver	SD1	30,306		9,623	
	SD2	12,340		4,523	
	SD3	47,750		19,175	
	SD4	12,050		13,149	
	SD5	32,030		620	
	SD6	24,900		5,417	
	SD7	12,600		1,489	
	SD8	17,420		2,265	
	SD9	7,400		1,484	
	SD10	34,530	231,326	18,376	76,121
Jefferson	SD11	8,630		8,454	
	SD12	7,060		1,454	
	SD13	21,530		1,983	
	SD14	16,231		1,111	
	SD15	5,940	59,391	1,534	14,536
Adams	SD16	23,290		8,551	
	SD17	300		417	
	SD18	2,705		429	
	SD19	6,660		3,819	
	SD20	7,830		1,147	
	SD29	302	41,087	1	14,364
Arapahoe	SD21	9,370		2,477	
	SD22	4,000		1,454	
	SD23	21,000		5,812	
	SD24	4,020	38,390	702	10,445
Douglas	SD25	95		0	
Boulder	SD26	1,950		980	
	SD33	17,900		1,797	
	SD34	110		3,931	
	SD35	2,660		2,557	
	SD36	2,040		248	
	SD37	2,680		152	
	SD38	6,830		1,705	
	SD39	600		173	
	SD40	55	34,825	0	11,543

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[a] Data from the Denver Regional Council of Governments.

It is assumed that the ratios of emissions from each source sector among the super districts are equal to the ratios of the characteristic parameter for each source sector. To provide a weighted allocation of particulate emissions to each district, the percentage of employment in each super district, as compared to the total in each county provided by the super district, is calculated (Table G-2) and then multiplied by the emissions from the corresponding point source sectors as given in Table G-3. (Particulates from the generation of electrical energy are not considered in the projections as there are no new power plants due for construction by 1985 and no announced expansion plans. Additional electrical requirements are expected to be absorbed by the new nuclear plant at Fort St. Vrain.) This provides an allocation of particulate point emissions to the super districts which is tabulated in Table G-4. (Allocation and projections for Douglas County are not made as only one super district is given.)

To project these emissions to 1975, 1980, and 1985, growth rates for the C-I employment and industrial employment are calculated from DRCOG data. The growth rates for 1975 and 1985 are interpolated by assuming that the employment grows at a rate such that half of the increase between 1970 and 1980 and 1980 and 1990 has occurred by 1975 and 1985, respectively. These growth rates are adjusted to the NEDS baseline year of 1972 and are presented in Table G-5.

The growth rates for C-I employment and industrial employment are then applied to the allocated C-I and industrial particulate emissions, respectively (Table G-4), for each super district. This provides estimates of the emissions for each point source sector and the total within each super district for the years 1975, 1980, 1985, and 1990, and these are given in Tables G-6, G-7, G-8, and G-9, respectively.

These total emission estimates are then used to calculate a general point source particulate emission growth rate for each super district.

Table G-2. PERCENTAGE OF EMPLOYMENT IN EACH SUPER DISTRICT (1970)

County	Area	C-I	Industrial
Denver	SD1	13.1	12.7
	SD2	5.3	5.9
	SD3	20.6	25.2
	SD4	5.2	17.3
	SD5	13.9	0.8
	SD6	10.8	7.1
	SD7	5.5	2.0
	SD8	7.5	3.0
	SD9	3.2	2.0
	SD10	14.9	24.2
Jefferson	SD11	14.5	58.3
	SD12	11.9	10.0
	SD13	36.3	13.7
	SD14	27.3	7.7
	SD15	10.0	10.6
Adams	SD16	56.7	59.5
	SD17	0.7	2.9
	SD18	6.6	3.0
	SD19	16.2	26.5
	SD20	19.1	8.0
	SD29	0.7	0.0
Arapahoe	SD21	24.4	23.7
	SD22	10.4	13.9
	SD23	54.7	55.6
	SD24	10.5	6.7
Douglas	SD25	100.0	100.0
Boulder	SD26	5.6	8.5
	SD33	51.4	15.6
	SD34	0.3	34.2
	SD35	7.6	22.2
	SD36	5.9	2.2
	SD37	7.7	1.3
	SD38	19.6	14.8
	SD39	1.7	1.5
	SD40	0.2	0.0

Table G-3. PARTICULATE POINT SOURCE EMISSIONS IN JRPP COUNTIES (1972 NEDS DATA - tons/year)

County	C-I	Industrial	Electrical	Total
Denver	131	1,920	401	2,451
Jefferson	646	7,271	0	7,917
Adams	13	2,719	749	3,481
Arapahoe	0	154	0	154
Douglas	0	379	0	379
Boulder	0	2,351	7,586	9,937

Table G-4. ALLOCATION OF PARTICULATE POINT EMISSIONS TO THE SUPER DISTRICTS - 1972 (tons/year)

County	Area	C-I	Industrial	Total
Denver	SD1	17	243	260
	SD2	7	114	121
	SD3	27	484	511
	SD4	7	332	339
	SD5	18	16	34
	SD6	14	137	151
	SD7	7	38	45
	SD8	10	57	67
	SD9	4	37	41
	SD10	20	464	484
Jefferson	SD11	94	4,238	4,332
	SD12	77	727	804
	SD13	234	995	1,229
	SD14	177	557	734
	SD15	65	769	834
Adams	SD16	7	1,618	1,625
	SD17	0	8	8
	SD18	1	52	53
	SD19	2	721	723
	SD20	2	217	219
	SD29	0	0	0
Arapahoe	SD21	0	36	36
	SD22	0	25	25
	SD23	0	84	84
	SD24	0	10	10
Douglas	SD25	--	--	
Boulder	SD26	453	200	653
	SD33	4,156	368	4,524
	SD34	26	804	830
	SD35	617	523	1,140
	SD36	474	51	525
	SD37	622	31	653
	SD38	1,586	349	1,935
	SD39	139	35	174
	SD40	13	0	13

Table G-5. GROWTH RATES OF EMPLOYMENT IN THE SUPER DISTRICTS (BASEYEAR 1972)

County	Area	C-I				Industrial			
		1975	1980	1985	1990	1975	1980	1985	1990
Denver	SD1	1.12	1.25	1.35	1.46	0.99	0.98	0.90	0.80
	SD2	1.13	1.26	1.39	1.52	1.08	1.16	1.16	1.25
	SD3	1.08	1.15	1.21	1.26	1.10	1.20	1.27	1.35
	SD4	1.11	1.25	1.34	1.44	1.15	1.30	1.45	1.60
	SD5	1.14	1.27	1.37	1.48	1.15	1.32	1.77	2.23
	SD6	1.15	1.28	1.33	1.48	0.99	0.98	0.97	0.97
	SD7	1.26	1.50	1.76	2.02	1.04	1.08	1.09	1.10
	SD8	1.16	1.33	1.49	1.65	1.06	1.13	1.16	1.19
	SD9	1.22	1.52	1.75	2.02	1.16	1.31	1.44	1.57
	SD10	1.11	1.22	1.31	1.39	1.11	1.22	1.29	1.37
Jefferson	SD11	1.20	1.40	1.55	1.71	1.26	1.52	1.82	2.11
	SD12	1.19	2.00	1.57	1.74	1.18	1.37	1.55	1.74
	SD13	1.23	1.47	1.73	2.00	0.95	0.89	0.86	0.82
	SD14	1.33	1.67	1.99	2.32	1.41	1.82	2.24	2.65
	SD15	0.99	0.99	0.89	0.79	2.38	3.75	5.05	6.34
Adams	SD16	1.23	1.46	1.67	1.87	1.16	1.32	1.46	1.61
	SD17	6.10	10.80	19.10	27.40	1.28	1.55	1.51	1.46
	SD18	1.38	1.74	1.85	1.97	2.25	3.11	3.42	3.74
	SD19	0.96	0.91	0.87	0.83	1.28	1.57	1.87	2.18
	SD20	1.25	1.49	1.85	2.20	1.20	1.38	1.47	1.56
	SD29	3.20	5.00	5.30	5.60	--	--	--	--
Arapahoe	SD21	1.40	1.80	2.29	2.77	1.31	1.76	1.87	2.11
	SD22	2.48	3.95	4.74	5.53	2.17	3.33	3.87	4.41
	SD23	1.20	1.39	1.58	1.78	1.10	1.19	1.25	1.31
	SD24	1.17	1.33	1.53	1.72	1.28	1.56	1.88	2.20
Douglas	SD25	--	--	--	--	--	--	--	--
Boulder	SD26	1.14	1.28	1.43	1.57	1.40	1.80	2.28	2.77
	SD33	1.17	1.33	1.50	1.67	1.03	1.06	1.07	1.08
	SD34	3.08	5.28	5.20	5.13	1.16	1.33	1.47	1.61
	SD35	1.26	1.52	1.63	1.73	1.20	1.40	1.49	1.58
	SD36	1.30	1.59	1.88	2.18	1.15	1.28	1.64	1.98
	SD37	1.33	1.66	1.75	1.77	2.94	4.85	5.10	5.35
	SD38	1.26	1.52	1.72	1.93	1.09	1.19	1.29	1.40
	SD39	2.79	4.58	5.41	6.24	2.63	4.28	5.10	5.92
	SD40	--	--	--	--	--	--	--	--

Table G-6. PROJECTED PARTICULATE POINT EMISSIONS IN THE SUPER DISTRICTS - 1975[a] (tons/year)

County	Area	C-I	Industrial	Total
Denver	SD1	19.4	239.7	259.1
	SD2	7.9	123.2	131.1
	SD3	29.0	532.7	561.7
	SD4	7.8	381.9	389.7
	SD5	20.5	18.3	38.8
	SD6	16.0	134.9	150.9
	SD7	8.8	39.1	47.9
	SD8	11.6	60.9	72.5
	SD9	5.3	43.1	48.6
	SD10	21.9	514.3	536.2
Jefferson	SD11	111.6	5342.0	5453.6
	SD12	93.2	862.0	955.2
	SD13	290.6	939.3	1229.9
	SD14	236.7	785.1	1021.8
	SD15	64.8	1821.2	1886.0
Adams	SD16	9.1	1875.2	1884.3
	SD17	--	10.1	10.1
	SD18	1.1	113.9	115.0
	SD19	2.0	925.4	927.4
	SD20	3.1	257.6	260.7
	SD29	--	45.9	45.9
Arapahoe	SD21	--	46.8	46.8
	SD22	--	54.6	54.6
	SD23	--	91.7	91.7
	SD24	--	13.0	13.0
Douglas	SD25	--	--	
Boulder	SD26	519.8	279.5	799.3
	SD33	4840.1	378.2	5218.3
	SD34	91.0	934.0	1025.0
	SD35	780.0	626.4	1406.4
	SD36	617.9	57.5	679.4
	SD37	831.8	89.4	921.2
	SD38	1993.6	381.9	2375.5
	SD39	389.5	95.0	384.5
	SD40			

[a] No control case.

Table G-7. PROJECTED PARTICULATE POINT SOURCE EMISSIONS IN THE SUPER DISTRICTS - 1980[a] (tons/year)

County	Area	C-I	Industrial	Total
Denver	SD1	21.7	236.8	258.5
	SD2	8.9	132.6	141.5
	SD3	31.0	581.0	612.0
	SD4	8.7	432.0	440.7
	SD5	22.8	20.9	43.7
	SD6	17.9	133.6	151.5
	SD7	10.5	40.7	51.2
	SD8	13.4	64.6	78.0
	SD9	6.6	48.8	55.4
	SD10	24.1	564.9	589.0
Jefferson	SD11	130.0	6445.6	6575.6
	SD12	109.5	997.0	1106.5
	SD13	347.0	883.9	1230.9
	SD14	297.0	1013.2	1310.2
	SD15	65.0	2873.1	2938.1
Adams	SD16	10.8	2132.6	2143.4
	SD17	0.1	12.4	12.5
	SD18	1.4	157.6	159.0
	SD19	1.9	1129.7	1131.6
	SD20	3.7	298.5	302.2
	SD29	0.3	91.5	91.8
Arapahoe	SD21	--	57.9	57.9
	SD22	--	84.0	84.0
	SD23	--	99.8	99.8
	SD24	--	15.9	15.9
Douglas	SD25	--	--	--
Boulder	SD26	586.4	358.7	945.1
	SD33	5524.0	388.9	5912.9
	SD34	156.0	1064.5	1220.5
	SD35	942.7	731.6	1674.3
	SD36	750.3	64.1	814.4
	SD37	1014.3	147.9	1189.2
	SD38	2401.0	415.2	2816.2
	SD39	640.0	154.7	794.7
	SD40			

[a] No control case.

Table G-8. PROJECTED PARTICULATE POINT SOURCE EMISSIONS IN THE SUPER DISTRICTS - 1985[a] (tons/year)

County	Area	C-I	Industrial	Total
Denver	SD1	23.5	215.9	239.4
	SD2	9.8	132.6	142.4
	SD3	32.6	616.8	649.4
	SD4	9.4	480.8	490.2
	SD5	24.7	28.1	52.8
	SD6	18.6	133.3	151.9
	SD7	12.3	41.1	53.4
	SD8	15.0	66.4	81.4
	SD9	7.6	53.7	61.3
	SD10	25.8	600.4	626.2
Jefferson	SD11	144.2	7704.7	7848.9
	SD12	122.8	1132.2	1255.0
	SD13	409.2	849.8	1259.0
	SD14	345.6	1242.1	1587.7
	SD15	58.3	3865.8	3924.1
Adams	SD16	12.3	2368.8	2381.1
	SD17	0.1	12.1	12.2
	SD18	1.5	173.4	174.9
	SD19	1.8	1351.0	1352.8
	SD20	4.6	316.8	321.4
	SD29	0.4	96.2	96.6
Arapahoe	SD21	--	66.7	66.7
	SD22	--	97.6	97.6
	SD23	--	104.9	104.9
	SD24	--	19.2	19.2
Douglas	SD25	--	--	--
Boulder	SD26	652.0	455.7	1107.7
	SD33	6238.5	392.6	6531.1
	SD34	426.4	1180.7	1606.1
	SD35	1006.3	777.4	1783.7
	SD36	888.1	81.8	969.9
	SD37	1097.8	155.4	1253.2
	SD38	2728.6	451.1	3179.7
	SD39	755.8	184.2	940.0
	SD40			

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[a] No control case.

Table G-9. PROJECTED PARTICULATE POINT SOURCE EMISSIONS IN THE SUPER DISTRICTS - 1990[a] (tons/year)

County	Area	C-I	Industrial	Total
Denver	**SD1**	25.3	194.8	220.1
	SD2	10.7	142.4	153.1
	SD3	34.1	652.6	686.7
	SD4	10.0	529.9	539.9
	SD5	26.5	35.3	61.8
	SD6	20.9	133.0	153.9
	SD7	14.5	41.5	56.0
	SD8	16.6	68.2	84.8
	SD9	8.8	58.6	67.4
	SD10	27.4	635.7	663.1
Jefferson	**SD11**	158.8	8963.8	9122.6
	SD12	132.6	1267.5	1403.7
	SD13	471.6	815.7	1287.3
	SD14	412.2	1470.9	1883.1
	SD15	51.6	4858.5	4910.1
Adams	**SD16**	13.8	2604.8	2618.6
	SD17	0.2	11.7	11.9
	SD18	1.6	189.3	190.9
	SD19	1.7	1572.1	1573.8
	SD20	5.4	335.1	340.5
	SD29	0.4	100.8	101.2
Arapahoe	**SD21**	--	75.5	75.5
	SD22	--	111.1	111.1
	SD23	--	110.0	110.0
	SD24	--	22.4	22.4
Douglas	**SD25**	--	--	--
Boulder	**SD26**	719.6	552.7	1272.3
	SD33	6953.8	396.3	7350.1
	SD34	151.4	1296.7	1348.1
	SD35	1069.3	823.2	1892.5
	SD36	1026.1	99.6	1125.7
	SD37	1154.3	163.0	1317.3
	SD38	3056.1	487.2	3543.3
	SD39	871.7	213.6	1085.3
	SD40			

[a] No control case.

As many of the point sources given in the NEDS are coming under controls promulgated by the State of Colorado, substantial reductions in point source emissions are due to occur by 1975. Therefore, projections should not be based on the 1972 data but on the controlled 1975 projected emission levels. The growth rates derived, and presented in the main text of this document (Section III), are then the ratios of 1980, 1985, or 1990 emission estimates to the projected 1975 emissions (uncontrolled case).

To provide the base year (1975) projections, all point sources producing more than 100 tons/year of particulate matter were investigated to see whether they were in compliance with state regulations. For all such point sources not in compliance, the process regulations given in the regulations are applied to provide an allowable emission level. Because the regulations are only applied to the sources of over 100 tons/year particulates and this presumes the maximum allowable emissions for these sources, it is assumed that this is a liberal (i.e., greater than expected) estimate of the level of emissions which can then be assumed to serve as the 1975 base year emissions. The total county point source particulate emissions before and after the state regulations are applied are given in Table G-10.

As can be seen from Table G-10, the state regulations have a significant impact on the expected emissions of particulates from point sources. This would produce a corresponding improvement in the air quality if point sources are major contributions to its degradation; however, as shown in Section IV, this is not the case.

Table G-10. POINT SOURCE EMISSION REDUCTIONS DUE TO PROMULGATED REGULATIONS - BY COUNTY

County	Tons/year emissions		Percent reduction
	1972	1975[a]	
Adams	2840	1603	44
Arapahoe	2468	308	88
Boulder	8411	1134	87
Denver	2802	1141	59
Jefferson	7797	928	88
Larimer	2372	384	84
Weld	6945	1746	75

[a] by application of promulgated point source regulations to all point sources over 100 tons/year particulates

APPENDIX H

PROJECTION OF AREA SOURCE PARTICULATE EMISSIONS

The majority of particulate emissions from traditional (non-fugitive) area sources in the Denver AQMSA occur within the Joint Regional Planning Program (JRPP) designated super districts. Therefore, most careful attention is paid to the projection of particulate emissions within this area while more rural regions are projected only after considering the results of the more extensive analysis of the super districts.

Due to the fact that different source sectors produce varying amounts of particulates in the various super districts and that these source sectors are assumed to grow at different rates with each super district, it is necessary to provide a weighting to each source sector and each super district within each county. The area source sectors chosen for consideration are residential, commercial-institutional (C-I), and industrial. The allocation scheme for each super district is then to consider the amount of population, C-I employment, and industrial employment within each super district. For the purpose of this study, the distribution of these parameters is considered not to have changed significantly between 1970, the last census presented in the Denver Regional Council of Governments (DRCOG) data; and 1972, the year of the National Emissions Data System (NEDS) emission inventory. The 1970-based population and employment figures for each super district (SD) are given in Table H-1. The population figures are the "total population" given in the DRCOG data. The C-I employment is the "total employment" minus the "mfg., trnsp., commn., util (mtcu)" which was considered to be the employment by industry.

Table H-1. POPULATION AND EMPLOYMENT IN THE SUPER DISTRICTS (1970)[a]

County	Area	Population	Total	C-I	Total	Industrial	Total
Denver	SD1	2,697		30,306		9,623	
	SD2	64,778		12,340		4,523	
	SD3	61,914		47,750		19,175	
	SD4	40,867		12,050		13,149	
	SD5	51,849		32,030		620	
	SD6	62,640		24,900		5,417	
	SD7	42,998		12,600		1,489	
	SD8	63,213		17,420		2,265	
	SD9	52,909		7,400		1,484	
	SD10	74,538	518,405	34,530	231,326	18,376	76,121
Jefferson	SD11	26,234		8,630		8,454	
	SD12	50,814		2,060		1,454	
	SD13	74,101		21,530		9,983	
	SD14	60,787		16,231		1,111	
	SD15	8,399	220,335	5,940	59,391	1,534	14,536
Adams	SD16	112,506		23,290		8,551	
	SD17	1,270		300		417	
	SD18	11,141		2,705		429	
	SD19	28,344		6,660		3,819	
	SD20	29,954		7,830		1,147	
	SD29	768	182,983	302	41,087	1	14,364
Arapahoe	SD21	49,050		9,370		2,477	
	SD22	20,411		4,000		1,454	
	SD23	67,597		21,000		5,812	
	SD24	19,427	156,485	4,020	38,320	702	10,445
Douglas	SD25	315		95		0	
Boulder	SD26	8,439		1,951		980	
	SD33	36,687		17,900		1,797	
	SD34	1,137		110		3,931	
	SD35	6,585		2,660		2,557	
	SD36	17,784		2,040		248	
	SD37	18,573		2,680		152	
	SD38	25,654		6,830		1,705	
	SD39	9,410		600		173	
	SD40	473	124,742	55	34,825	0	11,543

[a] Data from the Denver Regional Council of Governments

It is assumed that the ratios of emissions from each source sector among the super districts are equal to the ratios of the characteristic parameter for each source sector. To provide a weighted allocation of particulate emissions to each district, the percentage of population and employment in each super district, as compared to the total in each county provided by the super districts, is calculated (Table H-2) and then multiplied by the emissions from the corresponding area source sectors as given in Table H-3. (Particulates from the transportation sector are not considered at this time but are projected separately and averaged in later.) This provides an allocation of particulate area emissions to the super districts which is tabulated in Table H-4. (Allocation and projections are not made for Douglas County as only one super district is given.)

To project these emissions to 1975, 1980, and 1985, growth rates for the total population, C-I employment, and industrial employment, are calculated from the DRCOG data. The growth rates for 1975 and 1985 are interpolated by assuming that the population and employment grows at a rate such that half of the increase between 1970 and 1980 and 1980 and 1990 has occurred by 1975 and 1985, respectively. These growth rates are adjusted to the NEDS baseline year of 1972 and are presented in Tables H-5, H-6, H-7, and H-8.

These growth rates for population, C-I employment, and industrial employment are then applied to the allocated residential, C-I, and industrial particulate emissions, respectively (Table H-4), for each super district. This provides estimates of the emissions for each area source sector and the total within each super district for the years 1975, 1980, 1985, and 1990 and these are given in Tables H-9, H-10, H-11, and H-12, respectively.

These estimates of total area emissions from the residential, C-I, and industrial sectors are used to calculate a general stationary area source particulate emission growth rate for each super district. As these

Table H-2. PERCENTAGE OF POPULATION AND EMPLOYMENT IN THE SUPER DISTRICTS (1970)

County	Area	Population	C-I	Industrial
Denver	SD1	0.5	13.1	12.7
	SD2	12.5	5.3	5.9
	SD3	11.9	20.6	25.2
	SD4	7.9	5.2	17.3
	SD5	10.0	13.9	0.8
	SD6	12.1	10.8	7.1
	SD7	8.3	5.5	2.0
	SD8	12.2	7.5	3.0
	SD9	10.2	3.2	2.0
	SD10	14.4	14.9	24.2
Jefferson	SD11	11.9	14.5	58.3
	SD12	23.1	11.9	10.0
	SD13	33.6	36.3	13.7
	SD14	27.6	27.3	7.7
	SD15	3.8	10.0	10.6
Adams	SD16	61.5	56.7	59.5
	SD17	0.7	0.7	2.9
	SD18	6.1	6.6	3.0
	SD19	15.5	16.2	26.5
	SD20	15.8	19.1	8.0
	SD29	0.4	0.7	0.0
Arapahoe	SD21	31.3	24.4	23.7
	SD22	13.0	10.4	13.9
	SD23	43.2	54.7	55.6
	SD24	12.5	10.5	6.7
Douglas	SD25	100.0	100.0	100.0
Boulder	SD26	6.8	5.6	8.5
	SD33	29.4	51.4	15.6
	SD34	0.9	0.3	34.2
	SD35	5.3	7.6	22.2
	SD36	14.3	5.9	2.2
	SD37	14.9	7.7	1.3
	SD38	20.6	19.6	14.8
	SD39	7.6	1.7	1.5
	SD40	0.4	0.2	0.0

Table H-3. PARTICULATE AREA EMISSIONS IN JRPP COUNTIES
(1972 NEDS DATA - tons/year)

County	Residential	C-I	Industrial	Transportation	Total
Denver	359	393	4,011	2,422	7,186
Jefferson	164	167	1,348	527	2,205
Adams	128	173	581	384	1,265
Arapahoe	106	116	635	366	1,224
Douglas	9	20	20	24	72
Boulder	110	186	849	312	1,457

Table H-4. ALLOCATION OF PARTICULATE AREA EMISSIONS TO THE SUPER DISTRICTS - 1972 (tons/year)

County	Area	Residential	C-I	Industrial	Total
Denver	SD1	2	52	507	561
	SD2	45	21	238	304
	SD3	43	81	1,011	1,135
	SD4	28	21	693	742
	SD5	36	54	33	123
	SD6	43	42	286	371
	SD7	30	21	79	130
	SD8	44	30	120	193
	SD9	37	13	78	128
	SD10	52	59	969	1,080
Jefferson	SD11	20	24	786	830
	SD12	38	20	135	193
	SD13	55	61	184	300
	SD14	45	46	103	194
	SD15	6	17	142	165
Adams	SD16	79	98	346	523
	SD17	1	1	17	19
	SD18	8	11	17	36
	SD19	20	28	154	202
	SD20	20	33	46	99
	SD29	1	1	0	2
Arapahoe	SD21	33	28	147	208
	SD22	14	12	104	130
	SD23	45	63	345	453
	SD24	13	12	42	67
Douglas	SD25	--	--	--	--
Boulder	SD26	8	62	72	142
	SD33	32	564	133	729
	SD34	1	4	290	295
	SD35	6	84	189	279
	SD36	16	64	18	98
	SD37	16	85	11	112
	SD38	23	215	126	364
	SD39	8	19	13	40
	SD40	1	2	0	3

Table H-5. GROWTH RATES OF POPULATION AND EMPLOYMENT IN THE SUPER DISTRICTS - 1972 TO 1975

County	Area	Residential	C-I	Industrial
Denver	SD1	1.00	1.12	0.99
	SD2	0.90	1.13	1.08
	SD3	0.95	1.08	1.10
	SD4	1.04	1.11	1.15
	SD5	1.17	1.14	1.15
	SD6	1.10	1.15	0.99
	SD7	1.18	1.26	1.04
	SD8	1.09	1.16	1.06
	SD9	1.09	1.22	1.16
	SD10	0.96	1.11	1.11
Jefferson	SD11	1.41	1.20	1.26
	SD12	1.28	1.19	1.18
	SD13	1.13	1.23	0.95
	SD14	1.36	1.33	1.41
	SD15	2.27	0.99	2.38
Adams	SD16	1.20	1.23	1.16
	SD17	2.90	6.10	1.28
	SD18	1.14	1.38	2.25
	SD19	1.01	0.96	1.28
	SD20	0.89	1.25	1.20
	SD29	1.00	3.20	--
Arapahoe	SD21	1.41	1.40	1.31
	SD22	1.75	2.48	2.17
	SD23	1.09	1.20	1.10
	SD24	1.18	1.17	1.28
Douglas	SD25	--	--	--
Boulder	SD26	1.79	1.14	1.40
	SD33	1.11	1.17	1.03
	SD34	2.70	3.08	1.16
	SD35	1.51	1.26	1.20
	SD36	1.11	1.30	1.15
	SD37	1.18	1.33	2.94
	SD38	1.17	1.26	1.09
	SD39	1.65	2.79	2.63
	SD40	--	--	--

Table H-6. GROWTH RATES OF POPULATION AND EMPLOYMENT IN THE SUPER DISTRICTS - 1972 TO 1980

County	Area	Residential	C-I	Industrial
Denver	SD1	1.10	1.25	0.98
	SD2	0.79	1.26	1.16
	SD3	0.90	1.15	1.20
	SD4	1.08	1.25	1.30
	SD5	1.34	1.27	1.32
	SD6	1.19	1.28	0.98
	SD7	1.37	1.50	1.08
	SD8	1.18	1.33	1.13
	SD9	1.19	1.52	1.31
	SD10	0.93	1.22	1.22
Jefferson	SD11	1.84	1.40	1.52
	SD12	1.57	2.00	1.37
	SD13	1.26	1.47	0.89
	SD14	1.71	1.67	1.82
	SD15	3.50	0.99	3.75
Adams	SD16	1.40	1.46	1.32
	SD17	4.90	10.80	1.55
	SD18	1.30	1.74	3.11
	SD19	1.02	0.91	1.57
	SD20	1.27	1.49	1.38
	SD29	1.40	5.00	--
Arapahoe	SD21	1.79	1.80	1.76
	SD22	2.52	3.95	3.33
	SD23	1.30	1.39	1.19
	SD24	1.34	1.33	1.56
Douglas	SD25	--	--	--
Boulder	SD26	1.84	1.28	1.80
	SD33	1.20	1.33	1.06
	SD34	4.50	5.28	1.33
	SD35	2.20	1.52	1.40
	SD36	1.24	1.59	1.28
	SD37	1.33	1.66	4.85
	SD38	1.37	1.52	1.19
	SD39	2.26	4.58	4.28
	SD40	--	--	--

Table H-7. GROWTH RATIO OF POPULATION AND EMPLOYMENT IN THE SUPER DISTRICTS - 1972 TO 1985

County	Area	Residential	C-I	Industrial
Denver	SD1	1.15	1.35	0.90
	SD2	1.20	1.39	1.16
	SD3	0.98	1.21	1.27
	SD4	1.68	1.34	1.45
	SD5	1.46	1.37	1.77
	SD6	1.27	1.33	0.97
	SD7	1.48	1.76	1.09
	SD8	1.24	1.49	1.16
	SD9	1.16	1.75	1.44
	SD10	0.94	1.31	1.29
Jefferson	SD11	2.11	1.55	1.82
	SD12	1.59	1.57	1.55
	SD13	1.32	1.73	0.86
	SD14	1.84	1.99	2.24
	SD15	7.97	0.89	5.05
Adams	SD16	1.45	1.67	1.46
	SD17	9.30	19.10	1.51
	SD18	1.31	1.85	3.42
	SD19	1.00	0.87	1.87
	SD20	1.59	1.85	1.47
	SD29	1.50	5.30	--
Arapahoe	SD21	2.11	2.29	1.87
	SD22	3.33	4.74	3.87
	SD23	1.40	1.58	1.25
	SD24	1.33	1.53	1.88
Douglas	SD25	--	--	--
Boulder	SD26	2.14	1.43	2.28
	SD33	1.18	1.50	1.07
	SD34	5.00	5.20	1.47
	SD35	2.28	1.63	1.49
	SD36	1.25	1.88	1.64
	SD37	1.36	1.75	5.10
	SD38	1.44	1.72	1.29
	SD39	2.55	5.41	5.10
	SD40	--	--	--

Table H-8. GROWTH RATIO OF POPULATION AND EMPLOYMENT IN THE SUPER DISTRICTS - 1972 TO 1990

County	Area	Residential	C-I	Industrial
Denver	SD1	1.20	1.46	0.80
	SD2	0.78	1.52	1.25
	SD3	1.06	1.26	1.35
	SD4	1.26	1.44	1.60
	SD5	1.58	1.48	2.23
	SD6	1.35	1.48	0.97
	SD7	1.60	2.02	1.10
	SD8	1.30	1.65	1.19
	SD9	1.13	2.02	1.57
	SD10	0.94	1.39	1.37
Jefferson	SD11	2.37	1.71	2.11
	SD12	1.61	1.74	1.74
	SD13	1.39	2.00	0.82
	SD14	1.98	2.32	2.65
	SD15	12.40	0.79	6.34
Adams	SD16	1.50	1.87	1.61
	SD17	13.70	27.40	1.46
	SD18	1.34	1.97	3.74
	SD19	0.98	0.83	2.18
	SD20	1.91	2.20	1.56
	SD29	1.50	5.60	--
Arapahoe	SD21	2.42	2.77	2.11
	SD22	4.14	5.53	4.41
	SD23	1.50	1.78	1.31
	SD24	1.32	1.72	2.20
Douglas	SD25	--	--	--
Boulder	SD26	2.44	1.57	2.77
	SD33	1.16	1.67	1.08
	SD34	5.50	5.13	1.61
	SD35	2.35	1.73	1.58
	SD36	1.24	2.18	1.98
	SD37	1.38	1.77	5.35
	SD38	1.51	1.93	1.40
	SD39	2.85	6.24	5.92
	SD40	--	--	--

Table H-9. PROJECTED PARTICULATE AREA SOURCE EMISSIONS IN THE SUPER DISTRICTS - 1975 (tons/year)

County	Area	Residential	C-I	Industrial	Total
Denver	SD1	2.0	58.1	500.8	560.9
	SD2	40.2	23.7	257.6	321.5
	SD3	40.8	87.2	1112.8	1240.8
	SD4	29.2	23.4	797.8	850.4
	SD5	42.1	61.5	38.0	141.6
	SD6	47.3	48.1	281.9	377.3
	SD7	35.4	26.4	81.8	143.6
	SD8	47.9	34.8	127.2	209.9
	SD9	40.3	15.9	90.1	146.3
	SD10	50.0	65.5	1074.5	1190.0
Jefferson	SD11	28.1	28.8	990.6	1047.5
	SD12	48.7	23.8	158.8	232.3
	SD13	62.3	75.1	174.1	311.5
	SD14	61.0	61.2	145.6	267.8
	SD15	13.6	16.8	337.6	368.0
Adams	SD16	94.5	120.6	400.7	615.8
	SD17	2.9	6.1	21.8	30.8
	SD18	9.1	15.2	38.2	62.5
	SD19	20.1	26.8	197.8	244.7
	SD20	17.8	41.2	55.0	114.0
	SD29	1.0	3.2	15.3	19.5
Arapahoe	SD21	46.6	39.3	192.6	278.5
	SD22	24.5	29.7	225.3	279.5
	SD23	49.1	75.4	378.1	502.6
	SD24	15.3	14.0	53.7	83.0
Douglas	SD25	--	--	--	--
Boulder	SD26	11.1	70.5	100.9	182.5
	SD33	35.4	657.1	136.6	829.1
	SD34	2.7	12.3	337.2	352.2
	SD35	9.5	105.9	227.0	342.4
	SD36	17.8	83.1	20.7	121.6
	SD37	18.8	113.0	32.3	164.1
	SD38	27.0	270.6	136.9	434.5
	SD39	13.2	53.0	34.2	100.4
	SD40	1.0	2.0	--	3.0

Table H-10. PROJECTED PARTICULATE AREA SOURCE EMISSIONS IN THE SUPER DISTRICTS - 1980 (tons/year)

County	Area	Residential	C-I	Industrial	Total
Denver	SD1	2.2	64.8	494.7	561.7
	SD2	35.6	26.5	277.1	339.2
	SD3	38.9	93.2	1213.9	1346.0
	SD4	30.1	26.2	902.4	958.7
	SD5	48.3	68.5	43.6	160.4
	SD6	51.1	53.8	279.0	383.9
	SD7	41.0	31.5	85.0	157.5
	SD8	52.0	40.0	135.0	227.0
	SD9	43.9	19.7	102.1	165.7
	SD10	48.3	72.2	1180.3	1300.8
Jefferson	SD11	36.8	33.5	1195.3	1265.6
	SD12	59.6	29.9	184.9	272.4
	SD13	69.3	89.6	163.8	322.7
	SD14	76.8	76.7	187.9	341.4
	SD15	21.0	16.8	532.6	570.4
Adams	SD16	110.3	143.2	455.7	709.2
	SD17	4.9	10.8	26.3	42.0
	SD18	10.4	19.1	52.8	82.3
	SD19	20.4	25.6	241.4	287.4
	SD20	25.3	49.3	63.8	138.4
	SD29	1.4	5.0	30.5	36.9
Arapahoe	SD21	59.1	50.5	258.3	367.9
	SD22	35.3	47.4	346.5	429.2
	SD23	58.6	87.5	411.2	557.3
	SD24	17.4	16.0	65.6	99.0
Douglas	SD25	--	--	--	--
Boulder	SD26	14.7	79.6	129.5	223.8
	SD33	38.3	749.9	140.4	928.6
	SD34	4.5	21.1	384.5	410.1
	SD35	13.2	127.9	264.6	405.7
	SD36	19.9	101.9	23.1	144.9
	SD37	21.2	141.4	53.4	216.0
	SD38	31.5	325.9	150.0	507.4
	SD39	18.1	87.0	55.6	160.7
	SD40				

Table H-11. PROJECTED PARTICULATE AREA SOURCE EMISSIONS IN THE SUPER DISTRICTS - 1985 (tons/year)

County	Area	Residential	C-I	Industrial	Total
Denver	SD1	2.3	70.3	451.1	523.7
	SD2	54.1	29.2	277.1	360.4
	SD3	42.3	97.8	1288.6	1428.7
	SD4	32.7	23.2	1004.3	1065.2
	SD5	52.5	74.1	58.5	185.1
	SD6	54.5	55.8	278.5	388.8
	SD7	44.5	36.9	86.0	167.4
	SD8	54.6	44.7	138.7	238.0
	SD9	42.9	22.7	112.3	177.9
	SD10	48.7	77.2	1254.2	1380.1
Jefferson	SD11	42.1	37.2	1428.8	1508.1
	SD12	60.3	31.3	209.9	301.5
	SD13	72.8	105.7	157.5	336.0
	SD14	82.7	91.6	230.4	404.7
	SD15	47.8	15.1	716.6	779.5
Adams	SD16	114.3	163.3	506.2	786.8
	SD17	9.3	19.1	25.6	54.0
	SD18	10.5	20.4	58.2	89.1
	SD19	20.0	24.4	288.7	331.1
	SD20	31.7	60.9	67.7	160.3
	SD29	1.5	5.3	32.0	38.8
Arapahoe	SD21	69.5	64.0	274.5	408.0
	SD22	46.6	56.9	402.5	506.0
	SD23	63.1	99.7	432.3	595.1
	SD24	17.3	18.3	79.1	114.7
Douglas	SD25	--	--	--	--
Boulder	SD26	17.1	88.6	164.5	270.2
	SD33	37.7	847.0	141.8	1026.5
	SD34	5.0	20.8	426.1	451.9
	SD35	13.7	136.6	281.2	431.5
	SD36	20.0	120.6	29.5	170.1
	SD37	21.7	149.1	56.1	226.9
	SD38	33.2	370.4	162.9	566.5
	SD39	20.4	102.8	66.3	189.5
	SD40				

Table H-12. PROJECTED PARTICULATE AREA SOURCE EMISSIONS IN THE SUPER DISTRICTS - 1990 (tons/year)

County	Area	Residential	C-I	Industrial	Total
Denver	SD1	2.4	75.8	407.0	485.2
	SD2	35.0	31.9	297.6	346.5
	SD3	45.7	102.4	1363.4	1511.5
	SD4	35.3	30.2	1106.9	1172.4
	SD5	56.7	79.8	73.5	210.0
	SD6	57.9	62.1	277.9	397.9
	SD7	48.0	42.4	86.8	177.2
	SD8	57.1	49.5	142.5	249.1
	SD9	41.9	26.3	122.5	190.7
	SD10	49.1	82.1	1328.1	1459.3
Jefferson	SD11	47.4	41.0	1662.3	1750.7
	SD12	61.0	34.7	235.0	330.7
	SD13	76.3	121.8	151.2	349.3
	SD14	88.9	106.5	272.8	468.2
	SD15	74.6	13.4	900.6	988.6
Adams	SD16	118.3	183.4	556.6	858.3
	SD17	13.7	27.4	24.9	66.0
	SD18	10.7	21.7	63.5	95.9
	SD19	19.5	23.1	336.0	378.6
	SD20	38.2	72.5	71.6	182.3
	SD29	1.5	5.6	33.6	40.7
Arapahoe	SD21	79.9	77.5	310.7	468.1
	SD22	58.0	66.3	458.4	582.7
	SD23	67.5	111.9	453.4	632.8
	SD24	17.2	20.6	92.6	130.4
Douglas	SD25	--	--	--	--
Boulder	SD26	19.5	97.6	199.5	316.6
	SD33	37.0	944.1	143.1	1124.2
	SD34	5.5	20.5	468.3	494.3
	SD35	14.1	145.2	297.8	457.1
	SD36	19.9	139.3	35.9	195.1
	SD37	22.1	150.8	58.9	231.8
	SD38	34.8	414.8	175.9	625.5
	SD39	22.8	118.5	76.9	218.2
	SD40				

stationary area sources are not presumed to come under any controls, the base year emissions can be assumed to be those of the 1972 NEDS emission inventory. The growth rates derived for stationary area sources are then the rates of the 1975, 1980, 1985, or 1990 emissions estimates to the allocated 1972 emissions inventory (Table H-4). These stationary area source growth rates, base year 1972, are presented in Table H-13.

Since the transportation sector provides a substantial contribution to the total area source particulates (more than one-third in Denver County), it is necessary to also project any increased particulates from this source sector. Functional-system annual travel data by urban and rural areas is available from the Colorado Highway Department for the years of 1968 and 1990. This data is presented in Table H-14 along with the growth rate. Assuming a constant growth over the years, growth rates for 1975, 1980, 1985, and 1990 can be generated for the base year of 1972.

These growth rates do not represent the actual growth of particulates, due to the installation of catalytic mufflers which will have some effect in reducing the particulate emissions. Based on the fact that 61.7 percent, 94.2 percent, and 100 percent of cars (from Table L-3) are expected to be so equipped by 1980, 1985, and 1990, respectively, and that such cars will produce around 60 percent less particulates in their exhaust (or a total of 39 percent less since 37 percent of motor vehicle emissions are a result of tires), the actual growth rates of motor vehicle related particulate emissions can be calculated.

Using these growth rates and the proportionality of the contribution of particulates due to transportation sources (from Table H-3) it is possible to provide a rate of the growth of particulates due to all area sources. These weighted rates are presented in the text of the report (Section III).

Table H-13. STATIONARY AREA SOURCE GROWTH RATES BY SUPER DISTRICTS (BASEYEAR 1972)

County	Area	1975	1980	1985	1990
Denver	SD1	1.00	1.00	0.93	0.86
	SD2	1.06	1.12	1.19	1.14
	SD3	1.09	1.19	1.26	1.33
	SD4	1.15	1.29	1.44	1.58
	SD5	1.15	1.30	1.50	1.71
	SD6	1.02	1.03	1.05	1.07
	SD7	1.10	1.21	1.29	1.36
	SD8	1.09	1.18	1.23	1.29
	SD9	1.14	1.29	1.39	1.49
	SD10	1.10	1.20	1.28	1.35
Jefferson	SD11	1.26	1.52	1.82	2.11
	SD12	1.20	1.41	1.56	1.71
	SD13	1.04	1.08	1.12	1.16
	SD14	1.38	1.76	2.09	2.41
	SD15	2.23	3.46	4.72	5.99
Adams	SD16	1.18	1.36	1.50	1.64
	SD17	1.62	2.21	2.84	3.47
	SD18	1.74	2.29	2.48	2.66
	SD19	1.21	1.42	1.64	1.87
	SD20	1.15	1.40	1.62	1.84
	SD29	9.75	18.45	19.40	20.35
Arapahoe	SD21	1.34	1.77	1.96	2.25
	SD22	2.15	3.30	3.89	4.48
	SD23	1.11	1.23	1.31	1.40
	SD24	1.24	1.48	1.71	1.95
Douglas	SD25	--	--	--	--
Boulder	SD26	1.29	1.58	1.90	2.23
	SD33	1.14	1.27	1.41	1.54
	SD34	1.19	1.39	1.53	1.68
	SD35	1.23	1.45	1.55	1.64
	SD36	1.24	1.48	1.74	1.99
	SD37	1.47	1.93	2.03	2.07
	SD38	1.19	1.39	1.56	1.72
	SD39	2.51	4.02	4.74	5.46
	SD40	--	--	--	--

Table H-14. FUNCTIONAL-SYSTEM ANNUAL TRAVEL DATA[a]

County	Millions of vehicle miles		Growth rate 1968-1990
	1968	1990	
Adams	198.0	370.7	1.87
Urban	15.1	33.1	2.19
Rural[b]	182.9	337.5	1.85
Arapahoe	86.5	140.5	1.62
Urban	--	--	--
Rural[b]	86.5	140.5	1.62
Boulder	471.9	909.5	1.93
Urban	211.3	488.0	2.31
Rural[b]	260.6	421.5	1.62
Clear Creek	95.3	227.6	2.39
Urban	--	--	--
Rural[b]	95.3	227.6	2.39
Denver	3782.6	8467.6	2.24
Urban	3782.6	8467.6	2.24
Rural[b]	--	--	--
Douglas	207.3	432.4	2.09
Urban	--	--	--
Rural[b]	207.3	432.4	2.09
Gilpin	14.1	25.1	1.78
Urban	--	--	--
Rural[b]	14.1	25.1	1.78
Jefferson	273.3	653.1	2.39
Urban	--	--	--
Rural[b]	273.3	653.1	2.39
Larimer	443.8	827.5	1.86
Urban	134.5	272.8	2.03
Rural[b]	309.2	554.7	1.79
Weld	593.4	1020.1	1.72
Urban	106.6	209.5	1.97
Rural[b]	486.8	810.6	1.67

[a] Data from the Colorado Highway Department.

[b] Includes all cities less than 5,000 population.

APPENDIX I

The following gives a detailed explanation of the method used to allocate fugitive dust emissions.

1. Fugitive dust totals, in tons per year, were obtained from the PEDCo report. This information is given at the end of this Appendix in Table I-1.
2. Counties are divided into subunits, or zones. Each zone is an area where land use is specified. State land use maps are used to determine this.
3. Fugitive dust from agriculture is allocated only to cropland zones. Fugitive dust from sand on paved roads is assigned only to urban areas.
4. The county fugitive dust total minus the agricultural or sanding emissions constitute the fugitive dust which is allocated evenly throughout the county. In order to do this, the land area of each zone is calculated. If a specific zone is 20 percent of the county land area total, then this zone is allocated 20 percent of these nonassigned fugitive dust emissions.
5. The total fugitive dust for a given zone is the sum of agricultural or sanding emissions plus the nonassigned emissions total.
6. This total is expressed in final form as yearly emissions per $4\ \text{km}^2$ area.

The calculations are given below. The first set of calculations is explained to enhance the reader's understanding of the approach.

County	Zone	Emissions (tons/yr)	Area (km^2)	4 km^2	tons/yr/ 4 km^2
Adams	1	6358 + 0.66 (19,700) = 19,360	2025	506	38.26
	2	0.34 (19,700) = 6,698	1050	263	25.47

Explanation

Zone 1 in Adams County is cropland. Thus, it is assigned all agricultural emissions for the county, in this case 6,358 tons/yr. The land area of zone 1 is 66 percent of the county land area (2025/3075). It therefore is assigned 66 percent of the nonassigned emissions. The nonassigned emissions for Adams is the total fugitive dust (26,058) minus the agricultural emissions (6358), or 19,700 tons.

Zone 2 is rangeland. No specific emissions are assigned. The emissions from zone 2 is simply its land area as a percentage of total county land area multiplied by the nonassigned emissions.

County	Zone	Emissions (tons/yr)	Area (km^2)	tons/yr/ 4 km^2
Arrapahoe	1	821 + 0.34 (14,291) = 5680	691	32.88
	2	0.31 (14,291) = 4430	624	28.40
	3	0.35 (14,291) = 5002	700	28.58
Boulder	1	6586 + 0.24 (13,591) = 9848	468	84.17
	2	0.20 (13,591) = 2718	390	27.88
	3	0.56 (13,591) = 7611	1073	28.40
Clear Creek	Sole zone	7437	1000	29.75
Denver	Sole zone	8018	201	159.56
Douglas	Sole zone	5629	2267.5	9.93
Gilpin	Sole zone	18,228	340	214.45

County	Zone	Emissions (tons/yr)	Area (km^2)	tons/yr/ 4 km^2
Jefferson	1	2581 + 0.11 (15,221) = 4255	230	74.00
	2	0.37 (15,221) = 5632	735	30.65
	3	0.52 (15,221) = 7915	1044	30.33
Larimer	1	15,551 + 0.26 (20,203) = 20,804	1773	46.96
	2	0.62 (20,203) = 12,526	4275	11.72
	3	0.12 (20,203) = 2424	822	11.49
Weld	1	77,295 + 0.31 (37,317) = 88,863	868	102.38
	2	0.69 (37,317) = 25,749	7681	13.41

Table I-1. COLORADO AQMSA FUGITIVE DUST INVENTORY[a]

Fugitive dust sources	Adams	Arrapahoe	Boulder	Clear Creek	Denver	Douglas	Gilpin	Jefferson	Larimer	Weld
Unpaved roads	12,704	8,205	10,403	987	674	1,537	17,732	7,470	14,965	33,916
Sand on paved roads (snow control)	1,979	1,307	555	Neg.	5,816	Neg.	Neg.	2,581	Neg.	318
Agriculture	6,358	821	6,586	Neg.	Neg.	580	Neg.	328	15,551	77,295
Land development	240	975	278	20	Neg.	2,595	3	473	355	195
Residential and commercial construction	2,883	3,005	285	1,920	944	563	480	3,235	1,577	1,280
Highway construction	1,266	359	490	3,091	524	Neg.	Neg.	2,648	645	725
Quarrying, mining, and tailings	320	416	1,351	1,419	Neg.	328	11	1,056	2,520	88
Aggregate storage	164	24	124	Neg.	80	4	2	11	26	2
Cattle feedlots	144	Neg.	105	Neg.	Neg.	22	Neg.	Neg.	115	793
Total fugitive dust	26,058	15,112	20,177	7,437	8,018	5,629	18,228	17,802	35,754	114,612

[a] From PEDCo data

APPENDIX J

PROJECTION OF FUGITIVE DUST EMISSIONS

GENERAL

This appendix will describe the process by which future emissions of fugitive dust were estimated, both with and without proposed control measures.

Base data for the fugitive dust emissions were obtained from a report entitled, "Investigation of Fugitive Dust -- Sources, Emissions, and Control -- for Attainment of Secondary Ambient Air Quality Standards/ Colorado," performed by PEDCo-Environmental Specialists for EPA.[1] That report, which will be referred to hereinafter as the PEDCo report, included a 1972 inventory of fugitive dust sources, estimates of the possible degree of control by various techniques, and calculated reductions in emissions from recommended control strategies.

The starting point for the present analysis was the inventory data from the PEDCo report, reproduced in Appendix I as Table I-1.

The fugitive dust information from the PEDCo report was adjusted to obtain a representation of dust emissions from various parts of each county as described in Appendix I. Then, forecasts were made for two cases and then re-allocated in the manner described in Appendix I. The two cases were for (1) the degree of control required by present regulations and (2) the additional control resulting from regulations proposed in the contingency attainment plan (Section V). Each of these cases will be reviewed separately, and then forecasts of future emissions will be reviewed.

ESTIMATING CONTROL FROM EXISTING REGULATIONS

The Colorado Air Pollution Control Commission has recently approved a new regulation for control of fugitive dust. This regulation, Section II-D of Regulation Number 1, is provided in full in Appendix E and summarized in Section III. The regulation affects several types of dust sources, each of which will be discussed next.

Effect of Regulation by Source Types

Sources are reviewed in the same order as listed in Table I-1 in Appendix I.

Unpaved Roads - The promulgated regulation requires control techniques be applied to parking lots and unpaved roads with more than 165 vehicles per day (vpd). To determine the effect of this requirement involved several steps. This procedure is the same as was used by PEDCo but was applied to a limiting volume of 165 vpd instead of 250 vpd as in the PEDCo report. The procedure was:

1. A determination was made of the average amount of traffic on unpaved roads in each county. This information had been provided to PEDCo by the Colorado Division of Highways but was not included in their report and was thus obtained from PEDCo in a telephone conversation.[2] The data are listed in Table J-1.
2. A calculation was made of the percentage of total daily vehicle-miles of travel on unpaved roads which were on roads with more than 165 vpd. That is, this calculation determined what fraction of total VMT (and total emissions) are on roads controlled by the regulations. This step used the same procedure as used by PEDCo and is summarized in Table J-2. For the purpose of this step it was assumed that all roads with more than 165 vpd will be controlled

Table J-1. ESTIMATED AVERAGE DAILY TRAFFIC ON UNPAVED ROADS, BY COUNTY, 1972

County	Estimated average daily traffic[a]
Adams	30
Arapahoe	30
Boulder	40
Clear Creek	20
Denver	30
Douglas	30
Gilpin	20
Jefferson	50
Larimer	30
Weld	20

[a] Average daily traffic on all unpaved roads, estimated by Colorado Division of Highways and provided in Reference 2.

Table J-2. CALCULATION OF AMOUNT OF TRAFFIC ON CONTROLLED UNPAVED ROADS

(1) Avg. ADT for unpaved roads in county	(2) % of roads w/ADT of 165 vpd or more[a]	(3) Avg. ADT on roads w/ADT of 165 vpd or more	(4) Ratio of (3) to (1)	% of VMT on roads w/165 vpd or more ((2) x (4))
20	2.3	225	11.3	26.0
30	4.0	230	7.7	30.8
40	7.0	230	5.7	39.9
50	9.7	230	4.6	44.6

[a] Source: Figure 4.1, Reference 1.

to the extent estimated by PEDCo, whereas the regulation requires control of private roads and of public roads only to the extent allowed by financial resources. It was assumed that all eligible roads will be controlled by 1975, there being no basis for estimating what financial restraints may prevail. Consequently, the degree of control may be less than calculated here.

3. An estimate was made of what fraction of affected unpaved roads are within the Priority I portion of the county. (The existing regulation applies to only those unpaved roads and parking lots within the Priority I area shown in Figure 26.) This estimate was based upon judgment, using available information on development patterns and traffic volumes. This estimate is listed in Table J-3, which also shows the net reduction in emissions from this source, using the control efficiency of 60 percent from PEDCo.

Sand on Paved Roads, Agriculture - No control on these source categories is included in the promulgated regulations.

Land Development - Control efficiency was assumed to be 60 percent, as developed by PEDCo. This degree of control was assumed to apply to the portion of development occurring in the Priority I area, as tabulated in Table J-4, because the regulation applies only to that area.

Residential and Commercial Construction - Emission reductions were calculated from the PEDCo report's control efficiency of 50 percent. The area factors shown in Table J-5 were used because the regulation applies only in the Priority I area.

Highway Construction - Again, the regulations apply only to the Priority I area, so that area factors from Table J-4 (for land development activity) were used again, along with the PEDCo control efficiency of 37.5 percent.

Quarrying, Mining, and Tailings - The PEDCo control efficiency of 75 percent was used for all portions of all counties.

Table J-3. DEGREE OF CONTROL OF FUGITIVE DUST ON UNPAVED ROADS, BY COUNTY

County	(1) Fraction of travel affected[a]	(2) Portion of affected roads in Priority I area	(3) Control efficiency[b]	Net percentage reduction in emissions from unpaved roads ((1) x (2) x (3))
Adams	0.308	0.75	0.60	13.9
Arapahoe	0.308	0.60	0.60	11.1
Boulder	0.399	1.00	0.60	23.9
Clear Creek	0.26	0	0.60	0
Denver	0.308	1.00	0.60	4.8
Douglas	0.308	0	0.60	0
Gilpin	0.26	0	0.60	0
Jefferson	0.446	1.00	0.60	26.8
Larimer	0.308	0.50	0.60	9.2
Weld	0.26	0.75	0.60	11.7

[a] From Table J-2.

[b] From Reference 1.

Table J-4. ESTIMATED PERCENTAGE OF LAND DEVELOPMENT ACTIVITY IN PRIORITY I AREA, BY COUNTY

County	Estimated percentage[a]
Adams	90
Arapahoe	70
Boulder	100
Clear Creek	0
Denver	100
Douglas	0
Gilpin	0
Jefferson	100
Larimer	70
Weld	90

[a] Based upon data in maps published by Colorado Land Use Commission (Reference 3).

Table J-5. ESTIMATED PERCENTAGE OF RESIDENTIAL-COMMERCIAL CONSTRUCTION ACTIVITY IN PRIORITY I AREA, BY COUNTY

County	Estimated percentage[a]
Adams	90
Arapahoe	90
Boulder	100
Clear Creek	0
Denver	100
Douglas	0
Gilpin	0
Jefferson	100
Larimer	90
Weld	90

[a] Based upon data in maps published by Colorado Land Use Commission (Reference 3).

Aggregate Storage - The PEDCo control efficiency of 50 percent was applied to all portions of all counties.

Cattle Feedlots - No control regulations were promulgated for this source.

Net Effect - The new emissions, developed through the procedures outlined above, are shown in Table J-6. (These should be compared with Table I-1 in Appendix I to observe the reduction in emissions.) The emissions in Table J-6 were assumed to occur in 1975 and are the base case from which all further fugitive dust computations were made. These county totals were then allocated to the analysis zones through the procedures described in Appendix I, and Table 17 shows the result of this process. (The 1975 entries in Table 17 are the ratios of the emissions from Table J-6 to those in Table I-1, after allocation by zone.)

Table J-6. ESTIMATED 1975 FUGITIVE DUST EMISSIONS WITH PRESENT REGULATION NO. 1

Source category / County	Emissions of fugitive dust (tons per year)									
	Adams	Arapahoe	Boulder	Clear Creek	Denver	Douglas	Gilpin	Jefferson	Larimer	Weld
Unpaved roads	10,943	7,295	7,913	987	549	1,537	17,732	5,471	13,582	29,948
Sand on paved roads	1,979	1,307	555	--	5,816	--	--	2,581	--	318
Agriculture	6,358	821	6,586	--	--	580	--	8	15,551	77,295
Land development	110	565	111	20	0	2,595	3	189	206	90
Residential-commercial construction	1,586	1,653	142	1,920	472	563	480	1,617	867	704
Highway construction	839	265	306	3,091	327	0	0	1,655	476	480
Quarrying, mining, tailings	80	104	338	355	0	82	3	264	630	22
Aggregate storage	84	12	62	0	40	2	1	6	13	1
Cattle feedlots	144	0	105	--	--	22	--	--	115	793
Total	22,119	12,022	16,118	6,373	7,204	5,381	18,219	12,111	31,440	109,651

ESTIMATING CONTROL FROM PROPOSED ADDITIONAL REGULATIONS

The second case analyzed was for an assumed, more restrictive regulation for control of fugitive dust. The changes were described in Section V and are discussed below by source category.

Effect of Regulation by Source Types

Unpaved Roads - The regulation was assumed to apply throughout the AQMSA. Hence, the total reduction was found by using the data from Table J-3 except that the items in column (2) were all 1.00.

Sand on Paved Roads - All emissions were reduced by a control efficiency of 25 percent, as estimated by the PEDCo report.

Agriculture - No control regulations were assumed, in keeping with the finding of the PEDCo report that controls are not feasible.

Land Development, Residential-Commercial Contruction, Highway Construction - The same techniques were used except that area factors in Tables J-4 and J-5 were taken to be 1.0 because the proposed regulations would apply to the entire AQMSA.

Quarrying, Mining, and Tailings, Aggregate Storage - No additional control was assumed.

Cattle Feedlots - Based upon the discussion in the PEDCo report, it was assumed that emissions from this source category could be reduced by 50 percent; however, this was determined to have an insignificant impact on emissions and be politically infeasible.

Net Effect - Table J-7 lists the total emissions with the maximum control strategy described above. Again, it was assumed this degree of

Table J-7. ESTIMATED 1975 FUGITIVE DUST EMISSIONS WITH PROPOSED MAXIMUM CONTROL

County / Source category	Emissions of fugitive dust (tons per year)									
	Adams	Arapahoe	Boulder	Clear Creek	Denver	Douglas	Gilpin	Jefferson	Larimer	Weld
Unpaved roads	10,356	6,688	7,913	833	549	1,253	14,966	5,471	12,199	28,625
Sand on paved roads	1,484	980	416	--	4,362	--	--	1,936	--	239
Agriculture	6,358	821	6,586	--	--	580	--	328	15,551	77,295
Land development	96	389	111	8	0	1,038	1	189	142	78
Residential-commercial construction	1,442	1,503	142	960	472	281	240	1,617	788	640
Highway construction	792	225	306	1,932	327	0	0	1,655	403	453
Quarrying, mining, tailings	80	104	338	355	0	2	3	264	630	22
Aggregate storage	84	12	62	0	40	2	1	6	13	1
Cattle feedlots	144	0	105	--	--	22	--	--	115	793
Total	20,836	10,722	15,979	4,088	5,750	3,178	15,211	11,466	29,841	108,146

control would be applied by 1975. Also, these emissions were distributed among the zones with the procedures of Appendix I. The data for 1975 in Table 35 are the ratios of the emissions from Table J-7 to the emissions from Table I-1, after allocation.

FORECASTS OF GROWTH IN FUGITIVE DUST EMISSIONS

For each of the two sets of regulations, the two cases described above, projections were made of emissions in 1980 and 1985. Change between 1972 and 1975 was considered negligible. One projection was made for each year, and separately applied to the data in Tables J-6 and J-7. The growth projections will be discussed by source category.

Growth Projections by Source Category

Unpaved Roads - No change is assumed. Increased traffic and increased numbers of unpaved roads are assumed to be offset by increasing control.

Sand on Paved Roads - Emissions from this source were assumed to be proportional to vehicle-miles of travel (VMT), in accordance with the PEDCo report. Data on VMT by county were provided by the Colorado Division of Highways for 1968 and 1990 from the Colorado Classification, Needs, and Fiscal Study. Based upon those data (summarized in Appendix H), a linear interpolation was performed to develop the growth factors in Table J-8. Emissions from 1975 (Tables J-6 or J-7) were then multiplied by these factors to obtain future VMT.

Agriculture - This source category was assumed to remain constant. No data were available for projecting any change in the amount of land in agricultural use.

Table J-8. GROWTH FACTORS FOR SAND ON PAVED ROADS

County	Average annual VMT[a] growth rate, percent	Ratio of future VMT to 1975 VMT* (growth factor)	
		1980	1985
Adams	5.4	1.20	1.39
Arapahoe	2.8	1.12	1.23
Boulder	5.9	1.21	1.42
Clear Creek	6.3	1.22	1.44
Denver	5.6	1.20	1.40
Douglas	4.9	1.18	1.36
Gilpin	3.5	1.14	1.28
Jefferson	6.3	1.22	1.44
Larimer	4.7	1.18	1.36
Weld	4.4	1.17	1.34

[a] Vehicle-miles of travel, from reference 4.

Land Development, Residential and Commercial Construction - Emissions from both these sources were assumed to be proportional to the forecasted rate at which land would be converted to other uses, where such data were available. In other cases, population and employment projections were used. Each case will be described separately.

Counties in the JRPP area - Forecasts were provided by the Denver Regional Council of Governments (DRCOG) of future land use in the Joint Regional Planning Program (JRPP) area. Data aggregated by county were used, to be consistent with the other fugitive dust computations. For each county, "total used land" was reported for 1970, 1980, 1990, and 2000. The amount of land forecasted to be converted to use (i.e., the difference between two years' total used land) was the parameter used to describe the rate of construction activity. For Denver County, which is wholly in the area for which socioeconomic forecasts were done in the JRPP planning process, this parameter was used directly. For the other JRPP counties, population projections were examined in order to determine the portion of forecasted population increase (and thus, assumedly, development) which would occur in the JRPP area. The total growth factor for the county was taken to be the product of the growth factors for land use and population. This procedure, and resulting growth factors, are presented in Tables J-9 and J-10.

Counties outside JRPP area - Remaining counties were analyzed on the basis of the area source growth factors developed in Appendix H for other particulates.

Highway Construction - Emissions growth factors for this source were calculated in a manner exactly analogous to those for development and construction. The DRCOG land use forecasts for the JRPP area include a category for land used for roadways, and this statistic was used to develop growth factors for emissions from highway construction in the JRPP portion of each county. The same population factor as was used for construction and development was used to adjust for the expected amount of growth (and thus, assumedly, highway construction) in the whole county. For counties outside the JRPP area, the particulates area source growth factors from Appendix H were also used for highway construction. The resulting growth factors for fugitive dust from highway construction are shown in Tables J-11 and J-12.

Quarrying, Mining, and Tailings; Aggregate Storage; Cattle Feedlots - These source categories were judged to be unlikely to change markedly, and no data were available to provide a basis for projections. It was therefore assumed that emissions would not change over time.

Total Effect

Tables J-13 through J-16 show the predicted future emissions of fugitive dust from the procedures described above.

Table J-9. CALCULATION OF ACTIVITY GROWTH FACTORS FOR CONSTRUCTION AND DEVELOPMENT IN JRPP AREA

County	Total used land in JRPP portion of county, per JRPP forecasts, acres					Ratio of future growth rates to 1975 rates[a] (activity growth factor)	
	1970	Change, 1970 to 1980 (1)	1980	Change 1980 to 1990 (2)	1990	1980	1985
Adams	182,983	63,825	246,808	41,555	288,363	0.88	0.76
Arapahoe	16,318	9,212	25,530	6,482	32,012	0.86	0.72
Boulder	16,531	10,732	37,263	4,964	32,227	0.73	0.46
Denver	31,295	2,679	33,974	984	34,958	0.69	0.37
Douglas	2,709	2,642	5,351	4,803	10,154	1.41	1.82
Jefferson	27,562	10,727	38,289	7,525	45,814	0.85	0.70

[a] 1975 rate taken as 1.0.

1985 rate is ratio of column (2) to column (1).

1980 rate is average of 1975 and 1985 rates.

Table J-10. CALCULATION OF EMISSIONS GROWTH FACTORS FOR CONSTRUCTION AND DEVELOPMENT IN JRPP AREA, WITH ADJUSTMENT FOR POPULATION GROWTH

County	Population change						1985 population growth factor ((2) ÷ (1)) (3)	Activity growth factor[c]		Net emissions growth factors[d]	
	1970 to 1980			1980 to 1990							
	Portion of county		Ratio (1)	Portion of county		Ratio (2)		1980 (4)	1985 (5)	1980	1985
	JRPP[a]	Total[b]		JRPP[a]	Total[b]						
Adams	63,825	93,282	1.46	41,555	43,400	1.04	0.71	0.88	0.76	0.77	0.54
Arapahoe	95,969	97,180	1.01	77,303	78,300	1.01	1.00	0.86	0.72	0.86	0.72
Boulder	58,952	101,078	1.71	16,278	198,884	12.2	7.13	0.73	0.46	2.14	3.28
Denver[e]	-	-	-	-	-	-	-	0.69	0.37	0.69	0.37
Douglas	8,604	11,407	1.33	29,900	45,000	1.51	1.14	1.41	1.82	1.54	2.07
Jefferson	133,875	188,365	1.41	113,967	142,000	1.25	0.89	0.85	0.70	0.81	0.62

[a] Source: computer printout from DRCOG.

[b] Source: Colorado Division of Planning (1990 forecasts are by individual counties and are unofficial).

[c] From Table J-9.

[d] 1975 growth factor taken to be 1.0. 1980 growth factor is average of 1975 and 1985 factors. 1985 factor is product of column (3) and column (5)

[e] Denver is wholly within JRPP forecast area, so population adjustment is not necessary.

Table J-11. CALCULATION OF ACTIVITY GROWTH FACTOR FOR HIGHWAY CONSTRUCTION IN JRPP AREA

County	Land used for roadways in JRPP portion of county, per JRPP forecasts, acres					Ratio of future highway construction rates to 1975 rates (activity growth factor)[a]	
	1970	Change, 1970 to 1980 (1)	1980	Change, 1980 to 1990 (2)	1990	1980	1985
Adams	7,922	1,555	9,477	1,180	10,657	0.88	0.76
Arapahoe	7,799	1,716	9,515	1,194	10,709	0.85	0.70
Boulder	3,748	2,034	5,782	944	6,726	0.73	0.46
Denver	15,740	412	16,152	94	16,246	0.62	0.23
Douglas	542	582	1,124	912	2,036	1.29	1.57
Jefferson	7,698	1,957	9,655	1,290	10,945	0.83	0.66

[a] 1975 rate taken to be 1.0.

1985 rate is ratio of column (2) to column (1).

1980 rate is average of 1975 and 1985 rates.

Table J-12. CALCULATION OF EMISSIONS GROWTH FACTORS FOR HIGHWAY CONSTRUCTION IN JRPP AREA, WITH ADJUSTMENT FOR POPULATION GROWTH

County	1985 population growth factor[a] (1)	Activity growth factors[b]		Net emissions growth factors[c]	
		1980	1985 (2)	1980	1985
Adams	0.71	0.88	0.76	0.77	0.54
Arapahoe	1.00	0.85	0.70	0.85	0.70
Boulder	7.13	0.73	0.46	2.14	3.28
Denver[d]	-	0.62	0.23	0.62	0.23
Douglas	1.14	1.29	1.57	1.40	1.79
Jefferson	0.89	0.83	0.66	0.80	0.59

[a] From Table J-10.

[b] From Table J-11.

[c] 1975 factor taken as 1.0.
1985 factor is product of column (1) and column (2).
1980 factor is average of 1975 and 1985 factors.

Table J-13. ESTIMATED 1980 FUGITIVE DUST EMISSIONS WITH PRESENT REGULATION NO. 1

County / Source category	Emissions of fugitive dust (tons per year)									
	Adams	Arapahoe	Boulder	Clear Creek	Denver	Douglas	Gilpin	Jefferson	Larimer	Weld
Unpaved roads	10,943	7,295	7,913	987	549	1,537	17,732	5,471	13,582	29,948
Sand on paved roads	2,375	1,464	672	--	6,979	--	--	3,149	--	372
Agriculture	6,358	821	6,586	--	--	580	--	328	15,551	77,295
Land development	85	486	238	32	--	3,996	4	153	305	124
Residential-commercial construction	1,221	1,422	304	3,053	326	867	667	1,310	1,283	972
Highway construction	646	225	655	4,915	203	--	--	1,324	704	662
Quarrying, mining, tailings	80	104	338	355	--	2	3	264	630	22
Aggregate storage	84	12	62	--	40	2	1	6	13	1
Cattle feedlots	144	0	105	--	--	22	--	--	115	793
Total	21,936	11,829	16,873	9,342	8,097	7,006	18,407	12,005	32,183	110,189

Table J-14. ESTIMATED 1985 FUGITIVE DUST EMISSIONS WITH PRESENT REGULATION NO. 1

County	Emissions of fugitive dust (tons per year)									
Source category	Adams	Arapahoe	Boulder	Clear Creek	Denver	Douglas	Gilpin	Jefferson	Larimer	Weld
Unpaved roads	10,943	7,295	7,913	987	549	1,537	17,732	5,471	13,582	29,948
Sand on paved roads	2,751	1,608	788	--	8,142	--	--	3,717	--	426
Agriculture	6,358	821	6,586	--	--	580	--	328	15,551	77,295
Land development	59	407	364	41	--	5,372	5	117	381	153
Residential-commercial construction	856	1,190	466	3,917	175	1,165	806	1,003	1,604	1,197
Highway construction	453	186	1,004	6,306	75	--	--	976	881	816
Quarrying, mining, tailings	80	104	338	355	--	2	3	264	630	22
Aggregate storage	84	12	62	--	40	2	1	6	13	1
Cattle feedlots	144	--	105	--	--	22	--	--	115	793
Total	21,728	11,623	17,626	11,606	8,981	8,680	18,547	11,882	32,757	110,651

Table J-15. ESTIMATED 1980 FUGITIVE DUST EMISSIONS WITH MAXIMUM FEASIBLE CONTROLS

County / Source category	Emissions of fugitive dust (tons per year)									
	Adams	Arapahoe	Boulder	Clear Creek	Denver	Douglas	Gilpin	Jefferson	Larimer	Weld
Unpaved roads	10,356	6,688	7,913	833	549	1,253	14,966	5,471	12,199	28,625
Sand on paved roads	1,781	1,098	503	0	5,234	--	--	2,362	--	280
Agriculture	6,358	821	6,586	--	--	580	--	328	15,551	77,295
Land development	74	335	238	13	0	1,599	1	153	210	108
Residential-commercial construction	1,110	1,293	304	1,526	326	433	334	1,310	1,166	883
Highway construction	610	191	665	3,072	203	0	0	1,324	596	625
Quarrying, mining, tailings	80	104	338	355	0	2	3	264	630	22
Aggregate storage	84	12	62	0	40	2	1	6	13	1
Cattle feedlots	144	--	105	--	--	22	--	--	115	793
Total	20,597	10,542	16,713	5,913	6,352	3,891	15,305	11,218	30,480	108,632

Table J-16. ESTIMATED 1985 FUGITIVE DUST EMISSIONS WITH MAXIMUM FEASIBLE CONTROLS

County / Source category	Emissions of fugitive dust (tons per year)									
	Adams	Arapahoe	Boulder	Clear Creek	Denver	Douglas	Gilpin	Jefferson	Larimer	Weld
Unpaved roads	10,356	6,688	7,913	833	549	1,253	14,966	5,471	12,199	28,625
Sand on paved roads	2,063	1,205	591	--	6,107	--	--	2,788	--	320
Agriculture	6,358	821	6,586	--	--	580	--	328	15,551	77,295
Land development	52	280	364	16	--	2,149	2	117	263	133
Residential-commercial construction	779	1,082	466	1,958	175	582	403	1,003	903	1,088
Highway construction	428	158	1,004	3,941	75	--	--	976	746	770
Quarrying mining, tailings	80	104	338	355	--	2	3	264	630	22
Aggregate storage	84	12	62	--	40	2	1	6	13	1
Cattle feedlots	144	0	105	--	--	22	--	--	115	793
Total	20,344	10,350	17,429	7,103	6,946	4,590	15,375	10,953	30,420	109,046

APPENDIX J REFERENCES

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2. Telephone conversation on 25 June 1974 with Mr. Robert Amick, PEDCO-Environmental Specialists, Inc., Cincinnati.

3. Colorado Land Use Commission. Colorado Land Use Map Folio. Colorado Land Use Commission, Denver, Colorado, January 1974.

4. Wilbur Smith and Associates. Highway Classification, Needs, and Fiscal Study/Colorado/1970-1990. Colorado Department of Highways, Denver, Colorado, August 1972.

APPENDIX K

DETAILS OF THE CLIMATOLOGICAL DISPERSION MODEL (CDM) AND THE HANNA-GIFFORD MODEL

CLIMATOLOGICAL DISPERSION MODEL

The Climatological Dispersion Model (CDM) calculates ground level air concentrations of up to as many as two pollutants emitted from both point and area sources. Much of the following discussion closely parallels that given in EPA publication number R4-73-024, "User's Guide for the Climatological Dispersion Model." [1] The source input for this model includes area source strengths in gm/sec for a grid square of known size and effective height of the emissions above the ground. For point sources the emission rate in gm/sec is also required but the effective source height is calculated in terms of stack height, diameter, gas exit velocity, and temperature (for both the stack gas and the ambient air).

The basic meteorological input to the model takes the form of a joint frequency function ϕ (k, ℓ, m) which contains 576 entries giving the joint frequency of occurence of a wind direction, k, wind speed class, ℓ, and a stability index, m. The model requires 16 wind directions, 6 wind speed classes, and 6 stability classes. A tabulation by punched cards of this frequency distribution can be obtained for various localities in the United States from the National Climatic Center (NCC) in Asheville, North Carolina. The wind speeds associated with each wind speed class are given in Table K-1. The remaining meteorological input parameters are the average afternoon and nocturnal mixing height in meters. These can be obtained from EPA publication number AP-101, "Mixing Heights, Wind Speeds, and

Table K-1. CENTRAL WIND SPEEDS

Wind speed class	Speed interval, knots	Class wind speed, m/sec
1	0 to 3	1.50
2	4 to 6	2.46
3	7 to 10	4.47
4	11 to 16	6.93
5	17 to 21	9.61
6	> 21	12.52

Potential for Urban Air Pollution Throughout the Contiguous United States."[2] The values chosen for Denver were 2543 meters and 268 meters, respectively. The wind speeds given in Table K-1 are assumed to be taken at the 10 meter level. To account for the increase in wind speed with height, the following power law profile is assumed:

$$U(z) = U_\ell \ (z/z_0)^P \tag{K-1}$$

where $U(z)$ = wind speed (m/sec) at a height z

U_ℓ = wind speed (m/sec) at reference height of z_0 = 10 meters

p = exponent.

The variation of the exponent P with stability class is given in Table K-2.

The variation of the vertical dispersion function σ_z (ρ) with distance from the source (ρ) for a particular stability class is also given in terms of a power law expression.

$$\sigma_z \ (\rho) = a\rho^b \tag{K-2}$$

Values of a and b for different stability classes and distance ranges is given in Table K-3. The physical basis for this expression for the dispersion parameter may be understood in terms of the definition of σ_z:

$$\sigma_z = \sqrt{\frac{2\rho \ K_z}{U}} \tag{K-3}$$

where U = wind speed (m/sec)

K_z = coefficient of turbulent diffusion (m^2/sec).

Table K-2. EXPONENTS FOR WIND PROFILE

Stability class	Exponent (p)
1	0.1
2	0.15
3	0.20
4	0.25
5	0.25
6	0.30

Table K-3. PARAMETRIC VALUES FOR σ_z (ρ)

Stability class	Distance, meters					
	100 to 500		500 to 5000		5000 to 50,000	
	a	b	a	b	a	b
1	0.0383	1.2812	0.2539×10^{-3}	2.0886	-	-
2	0.1393	0.9467	0.4936×10^{-1}	1.1137	-	-
3	0.1120	0.9100	0.1014	0.9260	0.1154	0.9109
4	0.0856	0.8650	0.2591	0.6869	0.7368	0.5642
5	0.0818	0.8155	0.2527	0.6341	1.2969	0.4421
6	0.0545	0.8124	0.2017	0.6020	1.5763	0.3606

If the process of pollutant dispersal was one of simple diffusion the K_z would be constant and b would be equal to 0.5. Since this is not the case, a different set of power law parameters is required for each range of distances.

The orientations and distances of the point and areas sources with respect to the receptors of interest what angular sectors and radial distances are computed from source and receptor coordinates. The area sources must be broken down into smaller area elements for interpretation. The actual calculation process for all sources and pollutants is summarized by the following set of formulas taken from reference 1.

The average concentration $\overline{C}_A$ due to area sources at a particular receptor is given by

$$\overline{C}_A = \frac{16}{2\pi}\int_0^\infty \left[\sum_{k=1}^{16} q_k(\rho) \sum_{\ell=1}^{6} \sum_{m=1}^{6} \phi(k,\ell,m)\ S\ (\rho,z;U_\ell,P_m)\right] d\rho \qquad \text{(K-4)}$$

where k = index identifying wind direction sector

$q_k(\rho) = \int Q\ (\rho,\ \theta)\ d\theta$ for the k sector

$Q(\rho,\theta)$ = emission rate of the area source per unit area and unit time

ρ = distance from the receptor to an infinitesimal area source

θ = angle relative to polar coordinates centered on the receptor

ℓ = index identifying the wind speed class

m = index identifying the class of the Pasquill stability category

$\phi(k,\ell,m)$ = joint frequency function

$S\ (\rho,z;U_\ell,P_m)$ = dispersion function defined in Equations (K-4) & (K-5)

z = height of receptor above ground level

U_ℓ = representative wind speed

P_m = Pasquill stability category.

For point sources, the average concentration $\overline{C}_p$ due to n point sources is given by

$$\overline{C}_p = \frac{16}{2\pi} \sum_{n=1}^{n} \sum_{\ell=1}^{6} \sum_{m=1}^{6} \frac{\Phi(k_n,\ell,m)\; G_n S(\rho_n,z;U_\ell,P_m)}{\rho_n} \tag{K-5}$$

where k_n = wind sector appropriate to the nth point source

G_n = emission rate of the nth point source

ρ_n = distance from the receptor to the nth point source.

If the receptor is presumed to be at ground level, that is, $z = 0$, then the functional form of $S(\rho,z;U_\ell,P_m)$ will be

$$S(\rho,0;U_\ell,P_m) = \frac{2}{\sqrt{2\pi}\; U_\ell \sigma_z(\rho)} \exp\left[-\frac{1}{2}\left(\frac{h}{\sigma_z(\rho)}\right)^2\right] \exp\left(\frac{-0.692\rho}{U_\ell T_{1/2}}\right) \tag{K-6}$$

if $\sigma_z(\rho) \le 0.8$

$$S(\rho,0;U_\ell,P_m) = \frac{1}{U_\ell L} \exp\left(\frac{-0.692\rho}{U_\ell T_{1/2}}\right) \tag{K-7}$$

if $\sigma_z(\rho) \ge 0.8L$. New terms in Equations (K-6) and (K-7) are defined as follows:

$\sigma_z(\rho)$ = vertical dispersion function; i.e., the standard deviation of the pollution concentration in the vertical plane

h = effective stack height of source distribution; i.e., the average height of area source emissions in the kth wind direction sector at radial distance ρ from the receptor

L = the afternoon mixing height

$T_{1/2}$ = assumed half life of pollutant, hours.

The effective stack height h is the sum of the actual stack height h and the increment in source height Δh, which is given by

$$\Delta h = 1.6F^{1/3}U^{-1}\rho^{2/3} \qquad \rho \leq 3.5X^* \qquad \text{(K-8)}$$

$$\Delta h = 1.6F^{1/3}U^{-1}(3.5X^*)^{2/3} \qquad \rho > 3.5X^* \qquad \text{(K-9)}$$

where $X^* = 14F^{5/8}$ if $F \leq 55$

$X^* = 34F^{2/5}$ if $F > 55$

Δh = plume rise, meters

$F = gV_sR_s^2 \left[(T_s - T_a)/T_s\right]$

g = acceleration due to gravity, m/sec^2

V_s = average exit velocity of gases of plume, m/sec

R_s = inner radius of stack, meters

T_s = average temperature of gases in plume, ^oK

T_a = ambient air temperature, ^oK

U = wind speed at stack height, m/sec

ρ = distance from source to receptor, meters

HANNA-GIFFORD MODEL

The numerical integrations required by the CDM for analysis of area source contributors require large amounts of computer time and are really not justified by the degree of accuracy employed in the original area source emissions allocation procedure. For a simpler and more direct treatment of area source emissions the Hanna-Gifford area source model[3] was chosen.

The model is based upon the integral of gaussian plume contributions from upwind area sources. The ground level air pollutant concentration (χ) is then given by

$$\chi = \int_0^\infty dx \int_{-y_1}^{y_2} \frac{Q_a(x,y)}{\pi U \sigma_y \sigma_z} \exp\left[\frac{-y^2}{2\sigma_y^{\ 2}}\right] dy \qquad \text{(K-10)}$$

where χ = surface concentration ($\mu g/m^3$)

Q_a = area source strength ($\mu g/m^2/sec$)

U = wind speed (m/sec)

σ_y, σ_z = plume dispersion function (m)

x = distance upwind from the source (m)

y = crosswind distance from the plume centerline (m)

With this assumption that the plumes are narrow (i.e., y_1 and y_2 approach ∞) and that $Q_a(x)$ is a function of x only, equation (K-10) becomes

$$\chi = \int_0^D \sqrt{\frac{2}{\pi}} \frac{Q_a}{U\sigma_z} dx \qquad \text{(K-11)}$$

where D = limit of integration (m) for which further contributions is negligible.

To integrate equation (K-11) in closed form the vertical dispersion σ_z is again expressed in terms of the power law:

$$\sigma_z = ax^b \qquad \text{(K-12)}$$

If the integration distance is broken down into elements of length Δx, the following expression is obtained:

$$\chi = \frac{\sqrt{\frac{2}{\pi}}\left(\frac{\Delta x}{2}\right)^{1-b}}{a(1-b)\,U}\left[Q_0 + \sum_{i=1}^{N} Q_i \left((2i+1)^{1-b} - (2i-1)^{1-b}\right)\right] \qquad \text{(K-13)}$$

APPENDIX K REFERENCES

1. Busse, A. D. and Zimmerman, J. R. User's Guide for the Climatological Dispersion Model. EPA-R-4-73-024, December 1973.

2. Holzworth, G. C. Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States. Environmental Protection Agency, Office of Air Programs, Research Triangle Park, North Carolina, Office of Air Programs, Publication No. AP-101, January 1972.

3. Hanna, S. R. A Simple Method of Calculating Dispersion From Urban Area Sources. J. Air Poll. Contr. Assoc., 21:774-777, 1971.

APPENDIX L

PROCEDURES FOR CALCULATION OF PROJECTED EMISSION DENSITIES FOR THE DENVER METROPOLITAN GRID AND FOR THE CITIES OF BOULDER, FT. COLLINS, AND GREELEY

Following the procedure outlined by Kircher and Armstrong, the calculation of carbon monoxide, hydrocarbon, and nitrogen oxide emissions from light and heavy duty vehicle exhaust is given by the following summation:

$$e_{np} = \sum_{i = n - 12}^{n + 1} c_{ip} \, d_{ipn} \, m_{in} \, s_{np}$$

where e_{np} = emission factor in grams per vehicle mile for calendar year n and pollutant p

c_{ip} = emission rate for pollutant p (grams/mile) for the i^{th} model year at low mileage at a speed of 19.6 mi/hr. A list of these values used for Denver is given in Tables L-1(a) and (b)

d_{ipm} = emission deterioration factor for the i^{th} model year, calendar year n, and pollutant p. These deterioration factors for CO, HC, and NO_x are presented in Tables L-2(a), (b), and (c).

m_{in} = weighted annual travel of the i^{th} model year during calendar year n. Table L-3 gives weighted annual travel for light and heavy duty vehicles for the Denver area

s_{np} = speed adjustment factor for pollutant p and calendar year n.

s_{np} is evaluated in turn by the following expression:

$$s_{np} = \sum_{j = 1}^{k} r_{nj} \, v_{jp}$$

where k = total number of speeds

r_{jk} = fraction of total vehicle miles traveled (VMT) for speed j during year n

v_{jp} = speed correction factor for speed j and pollutant p. Figures L-1(a), (b), and (c) show how these correction factors vary with speed for CO, HC, and NO_x.

Evaporative and crankcase emissions can be evaluated as follows:

$$f_n = \sum_{i = n - 12}^{n + 1} h_i m_{in}$$

where f_n = combined evaporative and crankcase hydrocarbon emission factor for calendar year n

h_i = combined evaporative and crankcase emission rate for the i^{th} model year. These emission rates are listed in Table L-4.

m_{in} = weighted annual travel of the i^{th} model year during calendar year n.

To calculate actual emissions the factor e_{np} must be multiplied by the number of vehicle miles traveled (VMT) during a given time period. Average daily values of VMT for 240 grid squares (2 miles on a side) in the Denver Metropolitan Area were furnished by the Colorado Division of Highways. A map of the Denver Metropolitan Area showing the VMT grid centers is given in Figure L-2. These data, which were broken down according to road classification, were for the year 1972 with projected values given for the year 2000. The various road classifications and associated average speeds are given in Table L-5.

The spatial distribution of average daily values of VMT according to road type for the 240 grid squares are shown in Tables L-6(a) through (p) for the years 1972 and 2000. These data were then interpolated linearly to find VMT's for 1975, 1980, and 1985. Emissions of CO, HC, and NO_x were then calculated for each of these three years by use of the Kircher-Armstrong technique discussed previously. The results are given in Tables L-7(a) through (i). The breakdown of total VMT by light duty vehicle (LDV), heavy duty vehicle (HDV) and diesel is 94.7%, 5%, respectively.

Emission densities of CO, HC, and NO_x for the cities of Boulder, Ft. Collins, and Greeley were based upon functional-system annual by urban area for 1968 and 1990 listed in the Colorado Classifica Needs, and Fiscal Study. In Tables L-8(a) and (b) annual VMT for three cities is given as a function of road classification for 19 1990. After conversion to daily traffic flows the VMT data was i polated to find daily traffic volumes for 1975, 1980, and 1985. speeds used in the emission calculations for these cities are giv Table L-9.

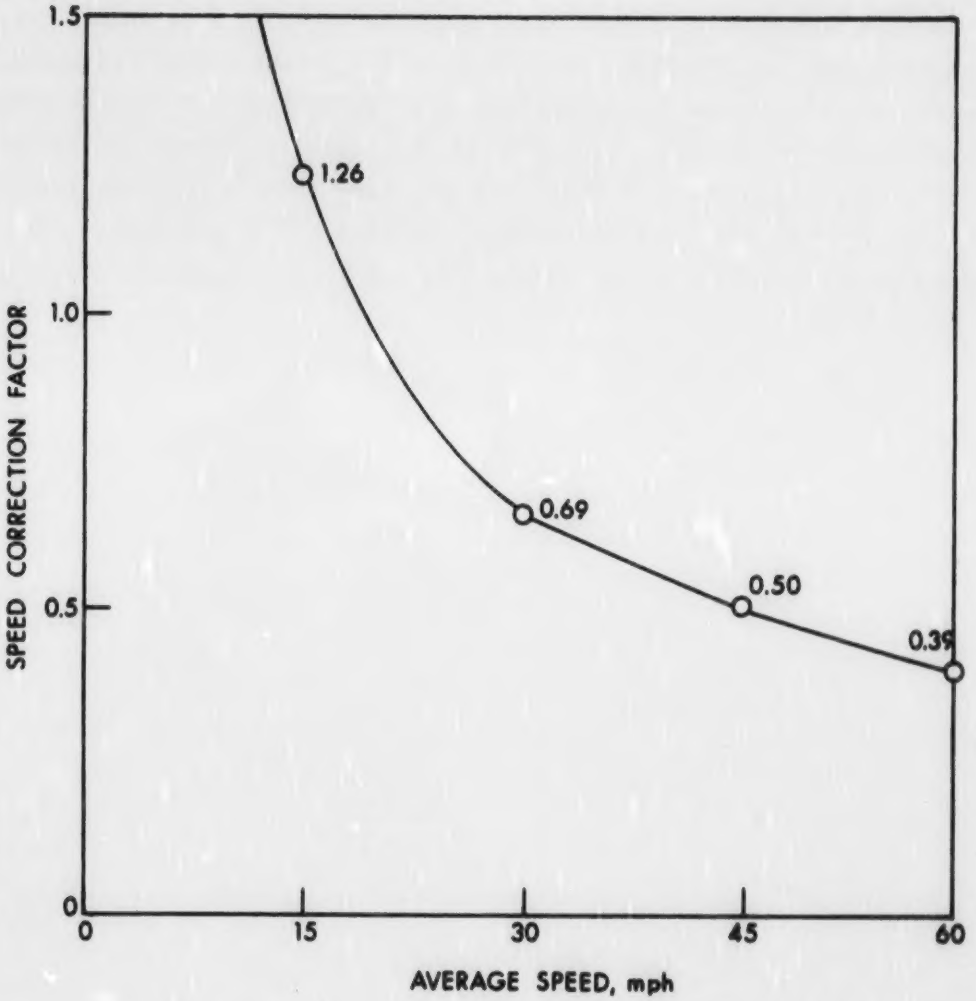

Figure L-1(a). Average speed correction factor for all model years, carbon monoxide

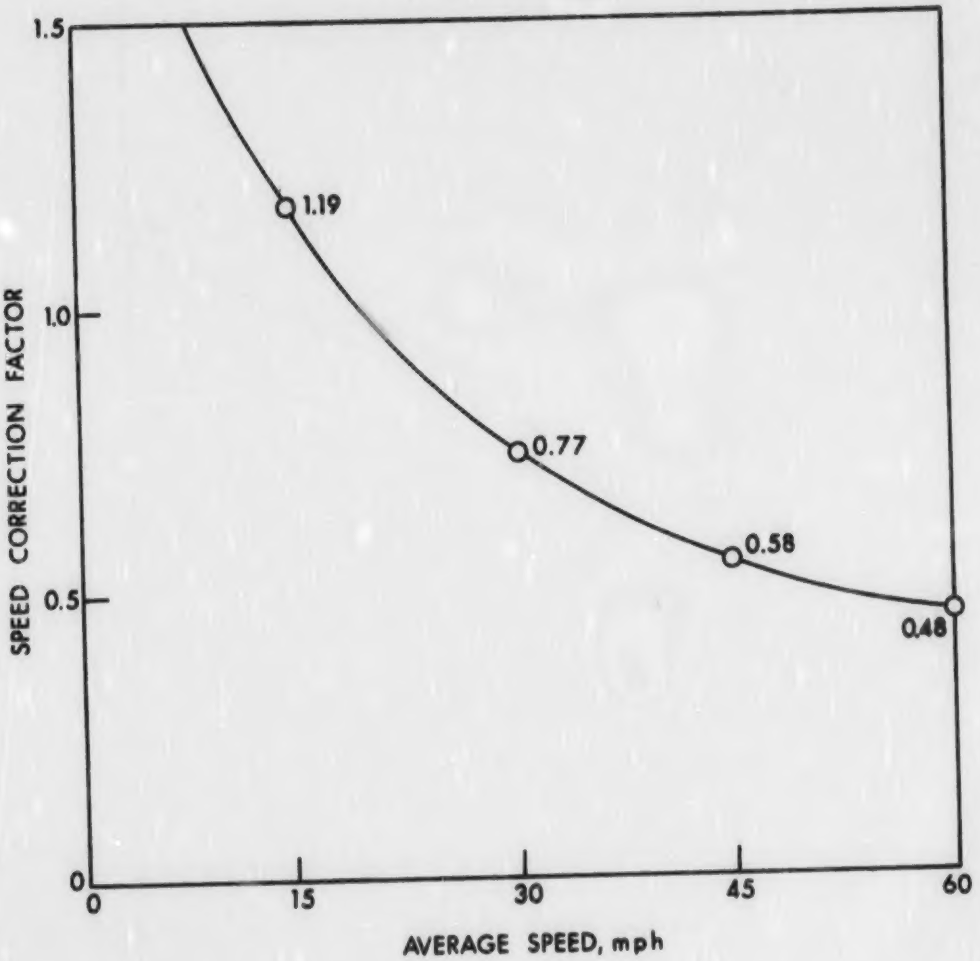

Figure L-1(b). Average speed correction factor for all model years, hydrocarbons

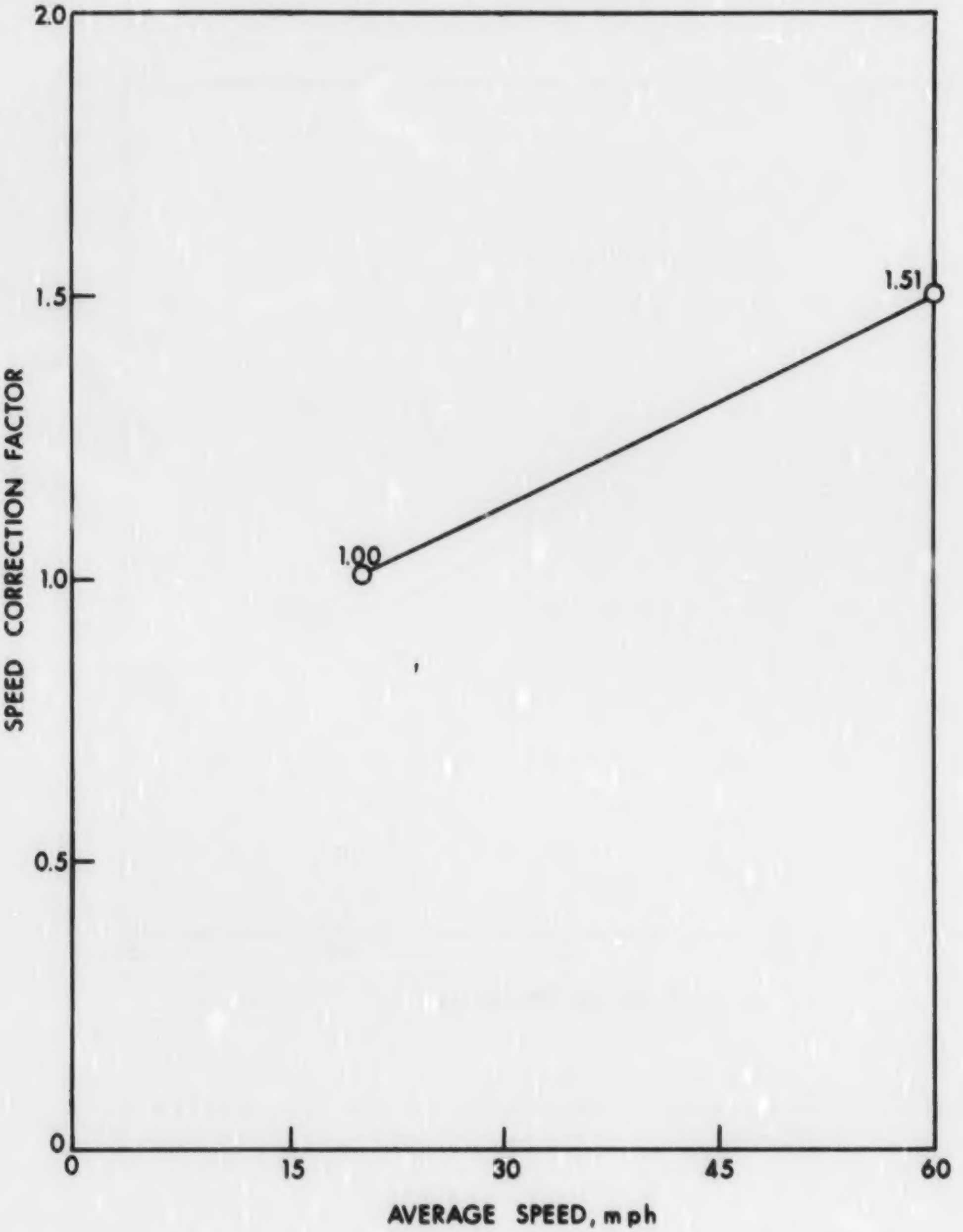

Figure L-1(c). Average speed correction factor for all model years, nitrogen oxides

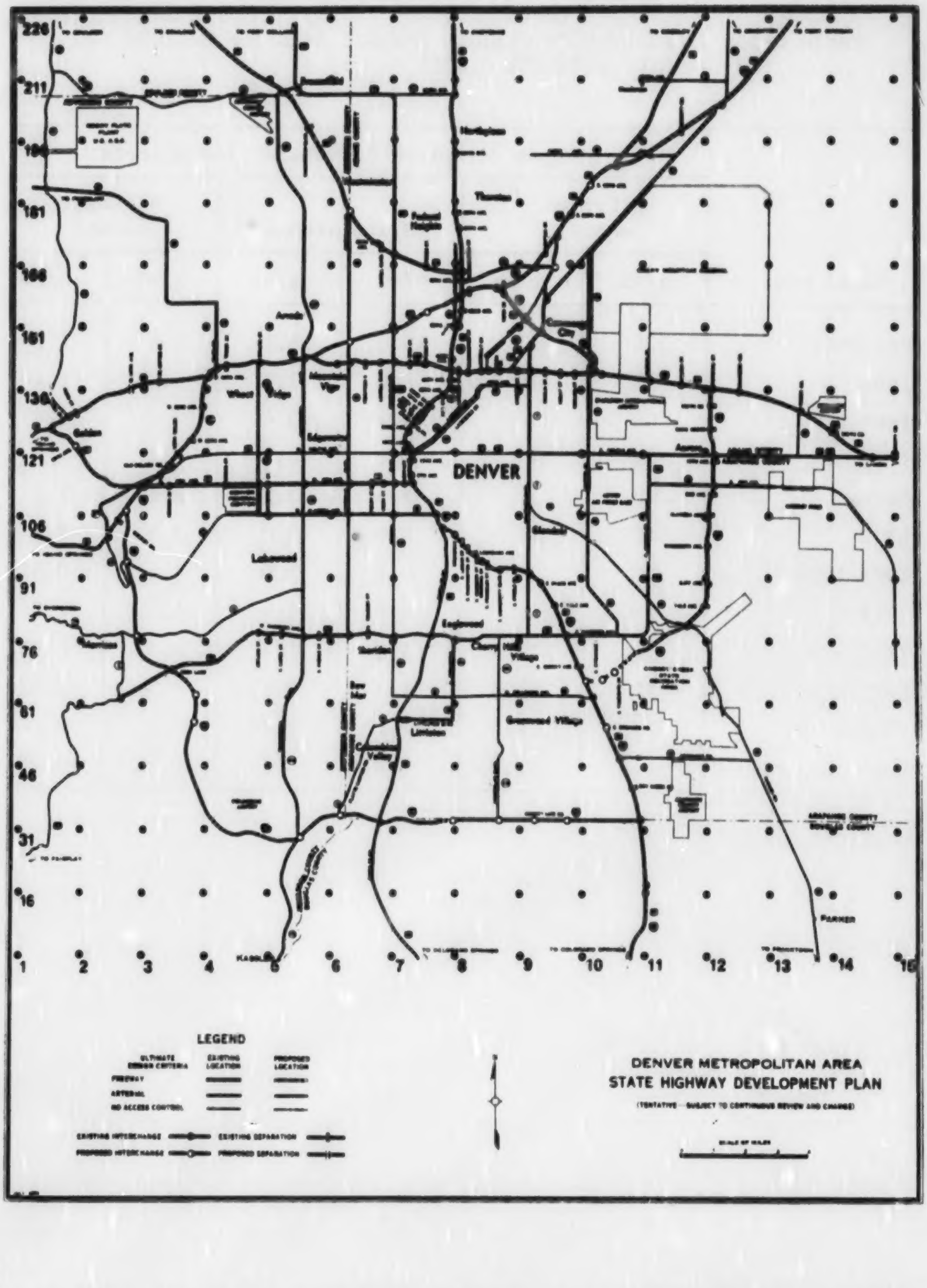
DENVER
DENVER METROPOLITAN AREA
STATE HIGHWAY DEVELOPMENT PLAN
(TENTATIVE - SUBJECT TO CONTINUOUS REVIEW AND CHANGE)
LEGEND
Lakewood
Englewood
Littleton
Greenwood Village
Parker
Kassler
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
226
211
196
181
166
151
136
121
106
91
76
61
46
31
16

Figure L-2. Map of the Denver Metropolitan Area showing VMT grid centers.

Table L-1(a). LIGHT-DUTY VEHICLE EXHAUST EMISSION FACTORS FOR HIGH-ALTITUDE CITIES (c_{ip})

Model year	Exhaust emission factors at low mileage					
	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Pre-1968	130	81	10	6.2	1.9	1.2
1968	74	46	6.0	3.7	2.2	1.4
1969	48	30	5.4	3.4	2.6	1.6
1970	72	45	6.1	3.8	2.8	1.7
1971	75	47	5.3	3.3	3.1	1.9
1972	42	26	4.9	3.0	3.1	1.9
1973-1974	42	26	4.9	3.0	1.4	0.87
1975	20	12	1.8	1.1	1.4	1.1
1976	20	12	1.8	1.1	1.3	0.81
1977	12.5	7.8	1.3	0.81	1.3	0.81
1978-1980	1.8	1.1	0.23	0.14	1.3	0.81
1981 and later	1.8	1.1	0.23	0.14	0.31	0.19

Table L-1(b). HEAVY-DUTY GASOLINE-POWERED VEHICLE EXHAUST EMISSION FACTORS FOR HIGH-ALTITUDE AREAS (c_{ip})

Model year	Carbon monoxide		Exhaust hydrocarbons		Nitrogen oxide	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Pre-1970	210	130	19	12	5.0	3.1
1970 through 1973	190	120	18	11	4.9	3.0
1974 and later	190	120	15	9.3	4.9	3.0

Table L-2(a). CARBON MONOXIDE DETERIORATION FACTORS FOR LIGHT-DUTY GASOLINE-POWERED VEHICLES IN ALL AREAS EXCEPT CALIFORNIA (d_{ipn})

	Vehicle age, years								
Model year	1	2	3	4	5	6	7	8	9 and older
1967 and earlier	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1968	1.24	1.35	1.41	1.47	1.53	1.58	1.63	1.67	1.72
1969	1.42	1.53	1.59	1.63	1.68	1.71	1.75	1.79	1.82
1970 through 1974	1.18	1.32	1.38	1.40	1.44	1.47	1.50	1.51	1.56
1975 through 1977	1.04	1.30	1.36	1.43	1.44	1.49	1.56	1.63	1.69
1978 and later	1.16	1.34	1.50	1.62	1.75	1.88	2.00	2.10	2.22

Table L-2(b). EXHAUST HYDROCARBON DETERIORATION FACTORS FOR LIGHT-DUTY GASOLINE-POWERED VEHICLES IN ALL AREAS EXCEPT CALIFORNIA (d_{ipn})

Model year	Vehicle age, years								
	1	2	3	4	5	6	7	8	9 and older
1967 and earlier	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1968	1.12	1.18	1.21	1.23	1.26	1.28	1.30	1.32	1.35
1969	1.10	1.16	1.18	1.21	1.23	1.25	1.28	1.29	1.31
1970 through 1974	1.05	1.10	1.13	1.15	1.17	1.20	1.22	1.24	1.26
1975 through 1977	1.00	1.13	1.22	1.29	1.37	1.43	1.50	1.56	1.63
1978 and later	1.14	1.30	1.44	1.55	1.67	1.77	1.88	1.96	2.07

Table L-2(c). NITROGEN OXIDE DETERIORATION FACTORS FOR LIGHT-DUTY GASOLINE-POWERED VEHICLES IN ALL AREAS EXCEPT CALIFORNIA (d_{ipn})

Model year	Vehicle age, years								
	1	2	3	4	5	6	7	8	9 and older
1972 and earlier	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1973 through 1974	1.11	1.18	1.20	1.21	1.22	1.23	1.24	1.25	1.26
1975	1.00	1.18	1.23	1.23	1.41	1.45	1.45	1.45	1.45
1976	1.03	1.07	1.10	1.13	1.17	1.19	1.21	1.24	1.26
1977 and later	1.17	1.37	1.53	1.67	1.82	1.94	2.06	2.17	2.32

Table L-3. WEIGHTED ANNUAL TRAVEL FOR LIGHT (LDV) AND HEAVY (HDV) DUTY VEHICLES

	Weighted annual travel (m_{in})	
Vehicle age (years)	LDV	HDV
0	0.013	0.003
1	0.075	0.095
2	0.123	0.164
3	0.122	0.121
4	0.101	0.114
5	0.091	0.097
6	0.092	0.088
7	0.089	0.064
8	0.074	0.054
9	0.059	0.036
10	0.052	0.028
11	0.025	0.018
12	0.026	0.015
13 +	0.061	0.103

Table L-4. LIGHT-DUTY AND HEAVY-DUTY VEHICLE CRANKCASE AND EVAPORATIVE HYDROCARBON EMISSIONS FOR ALL AREAS EXCEPT CALIFORNIA

Model year	LDV hydrocarbons		HDV hydrocarbons	
	g/mi	g/km	g/mi	g/km
Pre-1963	7.1	4.4	8.2	5.1
1963 through 1967	3.8	2.4	8.2	5.1
1968 through 1970	3.0	1.9	3.0	1.9
1971	0.5	0.3	3.0	1.9
1972	0.2	0.1	3.0	1.9
1973 and later	0.2	0.1	3.0	1.9

Table L-5. ROAD CLASSIFICATION AND SPEEDS FOR DENVER METROPOLITAN AREA

Classification	Speed (mi/hr)
Freeway	40
Expressway	34
Primary arterial	26
Minor arterial	23
Collector	21
Centroid connector	20
Ramps	20
Major arterial	23

Table L-6(a). AVERAGE DAILY VMT ON FREEWAYS IN 1972

FREE

0	0	0	43786	2284	0	0	40105	0	0	0	0	0	0	0
0	0	0	0	67023	0	0	44480	0	0	0	9662	989	0	0
0	0	0	0	5351	57818	0	73059	0	0	11620	6549	0	0	0
0	0	0	0	0	50150	13381	101105	0	5670	0	0	0	0	0
0	0	0	0	0	0	55001	228063	65197	2298	0	0	0	0	0
0	0	0	0	9138	39277	0	198771	38932	41530	0	0	0	0	0
0	22990	29047	69212	61060	67328	167423	345994	123259	87532	85163	50113	20779	8277	0
0	0	16739	9149	0	0	163295	0	0	0	0	20401	0	7195	4134
0	0	25974	19222	89835	136393	155448	139850	0	0	0	18481	0	0	0
0	0	0	0	0	0	0	62183	136551	26222	0	21392	0	0	0
0	0	0	7137	20994	29620	0	0	0	94792	16668	13228	0	0	0
0	0	3610	5654	0	0	0	0	0	77013	6204	0	0	0	0
0	0	0	0	0	0	0	0	0	0	44098	0	0	0	0
0	0	0	0	0	0	0	0	0	0	33531	0	0	0	0
0	0	0	0	0	0	0	0	0	0	24575	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table L-6(b). AVERAGE DAILY VMT ON EXPRESSWAYS IN 1972

EXPR

0	0	0	0	0	0	0	0	0	0	0	29912	10661	9518	0
0	0	0	0	11591	0	0	0	0	0	16736	13441	9257	0	0
0	0	0	0	16922	0	0	0	0	7645	34599	0	0	0	0
0	0	0	0	8527	967	0	0	0	47552	0	0	0	0	0
0	0	0	0	0	0	0	4946	12945	36412	0	0	0	0	0
0	0	0	0	0	0	0	0	55025	353	0	0	0	0	0
0	2271	0	0	0	0	0	0	5165	0	0	0	0	0	0
2035	25480	0	0	0	0	0	0	0	0	0	0	0	0	8043
0	809	36405	47060	0	0	15230	17378	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	11697	58346	22456	50399	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table L-6(c). AVERAGE DAILY VMT ON PRIMARY ARTERIALS IN 1972

PRAR														
0	0	0	0	16002	0	0	0	0	0	0	0	0	0	0
6807	0	0	0	13522	14715	15219	15254	0	0	0	1443	0	0	0
7504	0	0	0	0	0	21273	54555	6603	5883	2786	4345	0	0	0
6960	3109	4049	0	0	10542	32544	66121	9209	7072	5721	0	0	0	0
0	6635	5312	0	0	52988	68127	66520	3004	27600	0	0	0	0	0
0	5312	812	14526	51393	83684	58289	38714	26376	11457	0	[illegible]	0	0	0
293	3727	2148	11401	60441	161280	139218	150745	141153	92290	0	22397	0	0	0
2791	0	4078	23607	94121	175600	164790	361600	216829	137516	102692	62950	11083	6147	1203
0	762	0	11592	69713	143531	134979	269088	212247	100919	70784	21774	6280	569	0
0	0	2617	1947	8058	93007	75024	189826	176100	71447	32832	0	0	0	0
0	0	0	0	0	36418	39398	178224	80036	57559	30576	8343	0	0	0
0	0	0	0	16184	2190	101120	84728	49339	9972	7470	3700	2463	0	0
0	0	0	0	16425	5878	26962	27433	25867	10994	10001	7544	6299	0	0
0	0	0	0	4460	24970	18327	0	0	0	0	0	0	0	0
0	0	0	0	23012	4783	8144	0	0	0	0	0	0	0	0
0	0	0	0	6602	0	417	0	0	0	0	0	0	0	0

Table L-6(d). AVERAGE DAILY VMT ON MINOR ARTERIALS IN 1972

MTAR

0	0	0	797	1073	358	884	535	1411	0	1040	0	6046	0	0
594	3702	3322	0	1904	3806	1273	6211	5955	757	2267	159	4734	682	0
0	0	4236	0	432	10500	4446	3880	3963	2422	538	161	0	961	0
0	0	3338	1418	0	14390	9421	3247	3633	502	77	69	922	1015	0
0	1304	249	2046	24856	27727	12413	11938	827	4120	0	0	0	1043	0
0	0	5642	398	23148	43599	6653	15148	5829	15529	9878	1575	1047	956	0
0	7923	6543	8468	13350	35025	44977	27064	41118	19269	18051	3829	8409	1781	0
0	2706	4470	14629	21827	17507	58391	50050	14920	32121	59274	19739	7573	2867	34
0	8410	4369	51	14418	23331	63321	51295	30698	7041	5537	29204	5280	0	45
0	0	0	564	25805	16700	27515	32616	32996	15196	0	0	0	0	16
0	0	1572	0	14998	23333	25733	19827	23310	5721	7577	156	0	0	0
0	0	278	1555	7762	5650	27733	17351	7289	7685	5268	0	0	0	0
0	0	0	0	818	5567	8934	4562	13650	4544	497	0	0	0	0
0	0	0	0	331	2871	0	1898	6187	4015	496	0	0	0	0
0	0	0	0	0	50	0	0	0	0	0	0	0	0	0
0	0	0	0	70	654	2658	0	0	0	0	0	0	0	0

Table L-6(e). AVERAGE DAILY VMT ON COLLECTORS IN 1972

CLL

0	0	0	708	3015	599	367	16	349	362	165	378	478	0	0
0	0	0	0	8716	3523	1172	5756	3095	2685	1354	348	526	0	0
0	0	0	1567	4264	105	1797	26452	2271	2404	3232	1567	837	0	0
2	94	363	323	3617	2765	4162	13265	14004	4877	0	1	473	0	0
0	0	1554	2368	1151	8442	11334	15220	9745	15003	0	0	921	0	0
0	0	4607	9929	23202	10502	12729	4799	7893	9384	0	0	1153	68	0
0	3335	297	1835	6345	8376	30608	13559	15472	5549	0	6265	616	0	3
0	3794	0	3658	22414	24146	19353	16287	17638	6547	16211	19279	1816	0	3
0	0	0	4252	13884	15053	22564	23762	23878	4410	2688	5110	432	0	4
0	0	0	3300	14949	9079	31041	12028	23756	3445	13473	4506	1045	0	0
0	0	0	0	2150	2174	7028	44662	5083	4751	2549	3191	616	268	188
0	0	0	1503	980	6880	10036	15579	294	6062	3288	267	240	36	0
0	0	0	88	1178	1958	4951	16350	932	4226	846	445	2077	422	35
0	0	0	0	2340	1902	708	0	0	114	131	234	185	44	51
0	0	0	0	0	0	21	25	25	240	212	5	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table L-6(f). AVERAGE DAILY VMT ON CENTROID CONNECTORS IN 1972

CEC

0	0	0	8301	1162	65	1069	0	0	0	34	0	792	0	0
0	0	0	0	5530	4607	201	2991	2515	194	403	0	0	0	0
393	1914	2348	4126	63	117	1743	13380	3851	197	245	294	0	0	0
833	0	21	0	17	4450	10057	11400	7465	1122	936	0	0	0	0
0	0	549	2336	4650	3397	25294	13449	5254	14697	7599	2946	0	0	0
0	0	2516	2802	16251	7932	8190	17383	7799	7478	5544	267	0	0	0
0	3356	0	4989	8360	20084	12270	9591	12332	21556	5579	17707	1711	1051	94
0	8017	3310	11120	21125	21175	11585	40675	22750	14711	21728	15918	8899	2791	2717
0	1777	1919	5885	13789	22196	14429	25331	28039	17171	17133	6391	833	544	0
0	0	0	3395	17775	16839	15495	16920	21888	12264	8625	5529	193	28	0
0	0	0	129	4182	14290	8599	16918	12963	15931	8803	969	0	0	57
0	0	102	273	641	4486	12460	22034	7817	845	4953	246	0	59	0
0	0	0	0	28	2353	6969	15428	9512	3284	949	177	653	442	181
0	0	0	0	1329	1739	610	0	5022	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1284	59	0	0	0	0	0	0	0	0	0

Table L-6(g). AVERAGE DAILY VMT ON RAMPS IN 1972

RAMP

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	813	565	0	0	0	0	0	0
0	0	0	0	315	0	818	0	0	0	0	0	0	0	0
0	0	0	0	0	0	125	2615	0	0	0	0	0	0	0
0	0	0	0	0	0	0	3347	301	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table L-6(h). AVERAGE DAILY VMT ON MAJOR ARTERIALS IN 1972

MAAR

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1081	4839	3336	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	3335	0	0	0	0	0	0	0
0	0	0	0	0	0	5684	7809	6134	0	0	0	0	0	0
0	0	0	0	0	0	15448	1341	21289	0	0	0	0	0	0
0	0	0	0	0	0	12535	8335	4349	0	0	0	0	0	0
0	5694	7106	12191	14439	2454	39360	0	0	0	0	0	0	0	0
0	25280	29349	13432	12968	14469	750	159524	127202	72811	8121	0	0	0	0
0	0	1378	21846	0	1022	0	63279	0	16610	0	0	0	39	47
0	0	0	15253	18945	29610	25672	59688	5348	37915	5206	0	0	0	104
0	0	2413	6232	1349	0	0	19202	7010	5486	0	0	0	0	123
0	0	0	0	0	0	0	0	0	0	0	0	0	0	38
0	0	0	0	660	2773	442	15599	6397	0	0	0	4839	0	0
0	0	0	0	21	0	6054	13139	3298	0	0	0	7919	2361	0
0	0	0	0	100	0	0	0	0	0	0	0	0	6693	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table L-6(i). AVERAGE DAILY VMT ON FREEWAYS IN THE YEAR 2000

```
FREE
      0      0      0 102351    342      0      0 123096      0      0      0      0  18653   9878      0
      0      0      0      0 163262      0      0 162603      0      0      0  19651  14710      0      0
      0      0      0      0  14781 159200      0 223954      0  15555  37663  10100      0      0      0
      0      0      0      0      0 143420  53414 299583      0 102581      0      0      0      0      0
      0      0      0      0      0      0 169833 693846 229710   8027      0      0      0      0      0
      0      0      0      0  19329 155783 110621 472085 106658 132869      0      0      0      0      0
      0  20339  20192 153338 213174  79099 237640 656534 204171 375033 220355 176646  92515  30528      0
   2833  39472  49104  26023 154398      0 470033      0      0 184992      0  75468      0  26249  40678
      0  21381 167916 137473 377189 266038 353770 525572      0 137790      0 109061      0      0      0
      0      0  54595  64817  95323      0      0 469041 337017  76423      0 113126      0      0      0
      0      0  60683  24814 241866 208539 294737 434741 187978 413748 112446  80088      0      0      0
      0      0  27116  59911      0      0 256663      0      0 362550  55063      0      0      0      0
      0      0      0  38942      0      0 115314      0      0      0 219541      0      0      0      0
      0      0      0  24660  81016 125926 143697  58321  52286  28374  74915      0      0      0      0
      0      0      0      0   8102  21847      0      0      0      0  72441      0      0      0      0
      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
```

Table L-6(j). AVERAGE DAILY VMT ON EXPRESSWAYS IN THE YEAR 2000

```
EXPR
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0 4120    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0 1663    0    0    0    0    0    0    0 5338
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0  571    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
```

Table L-6(k). AVERAGE DAILY VMT ON PRIMARY ARTERIALS IN THE YEAR 2000

PRAR

0	0	0	0	23303	0	0	0	0	0	0	57689	0	0	0
1088	0	6977	23478	63157	38707	30271	45591	10514	5812	39393	37973	2332	0	0
0	0	32411	41316	13395	81675	36784	92142	14220	0	61159	30857	0	0	0
0	0	38163	43244	26663	87274	36653	64258	18016	8350	37072	0	0	0	0
0	0	43434	34884	8392	97300	92802	69037	37806	61439	0	0	0	0	0
0	0	20230	96888	59721	137526	122593	65662	79443	3569	0	0	0	0	0
0	0	0	17838	84547	145342	178957	229374	140481	21256	0	28834	19517	0	0
4955	1194	14193	10524	18966	148572	148723	503743	231686	22293	41219	73991	59563	12986	3106
0	26952	12157	18989	41830	151539	170553	410668	392513	137925	133377	94168	56366	6408	0
0	0	6537	13044	24377	121798	103010	130456	224717	211988	136449	45845	34458	0	0
0	0	2524	6031	29256	73914	41344	72188	107392	40649	130435	91579	36061	0	0
0	0	0	2601	106353	11923	134734	112010	86730	39179	71632	19988	35733	0	0
0	0	0	21868	111569	93480	66129	29486	102496	81587	189804	84975	90766	0	0
0	0	0	6212	54556	53454	42798	18555	32443	10163	18095	25924	51642	9035	0
0	0	0	0	65022	4629	40224	1442	3165	1040	2968	3331	0	16675	0
0	0	0	0	19836	0	22774	0	0	0	0	0	0	0	0

Table L-6(1). AVERAGE DAILY VMT ON MINOR ARTERIALS IN THE YEAR 2000

MIAR

0	0	0	1350	10346	7898	4135	6929	2174	0	5926	0	0	0	0
0	0	0	0	22752	24274	25407	42799	2828	3519	4084	0	7749	3098	0
0	0	0	0	2448	5037	0	13896	14595	5988	0	0	0	2767	16
1870	719	1811	0	9184	3601	11781	51874	13919	22	0	0	223	3353	12
0	90	2828	0	18876	2396	2845	10344	3321	0	0	0	0	3029	12
0	2950	8803	21499	36994	9460	4161	8025	5057	341	5277	759	938	3511	31
593	0	0	6034	11677	40597	40568	17384	48969	10028	14898	1266	0	3566	19
0	9272	0	4634	0	0	35360	88876	37203	29537	5854	16096	0	5143	4413
0	0	0	0	0	0	10105	682	26997	11953	32652	0	0	0	0
0	0	0	3877	0	3595	37102	46191	22637	7320	3664	6936	0	0	0
0	0	0	8161	15470	33076	47576	116088	52698	8582	20133	639	0	0	0
0	0	0	75834	0	6439	71477	15943	24508	18717	11692	0	0	0	0
0	0	0	19267	168	17969	32137	0	7314	139	19083	4377	0	0	0
0	0	0	3536	916	865	2251	24666	19066	9311	26983	8737	0	0	0
0	0	0	0	0	202	8231	11391	2512	138	3893	3843	0	0	0
0	0	0	0	524	4345	3234	0	0	0	0	0	0	0	0

Table L-6(m). AVERAGE DAILY VMT ON COLLECTORS IN THE YEAR 2000

CLL

0	0	0	0	0	182	45	0	2220	2335	1250	1647	427	0	0
0	26	0	714	963	6037	0	16316	18706	3375	2834	271	4	1814	0
0	0	0	0	744	734	18044	58605	10984	8054	5400	9351	1968	303	0
0	0	204	3044	0	27417	26499	14965	12063	9085	0	10	0	28	0
0	0	3700	10859	30042	24819	41073	18621	6133	25355	0	0	148	64	0
0	30	12121	20967	43700	31801	22994	7799	6619	13549	0	6107	4659	146	16
0	3397	4753	5438	17467	16655	51534	33533	49366	38531	6599	59252	3813	0	506
0	2958	7497	23375	50391	21730	37412	44037	31303	45572	65169	40364	0	0	2004
0	8306	13035	4934	28655	52070	70681	35540	44699	11484	15129	40806	216	0	556
0	0	0	964	17145	18157	42356	45716	69380	30141	33692	5217	859	0	184
0	0	4161	1394	13610	35605	14849	55448	8247	35768	17425	892	3068	0	0
0	0	775	104	0	5013	10420	7941	189	20688	32530	564	7702	13806	0
0	0	0	0	0	16783	40732	36115	17186	8911	30803	161	0	5705	0
0	0	0	0	11365	6893	9703	9438	8799	620	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table L-6(n). AVERAGE DAILY VMT ON CENTROID CONNECTORS IN THE YEAR 2000

CEC

0	0	0	0	3732	4913	9306	0	0	112	505	0	1550	0	0
0	4	0	0	6477	13522	2456	16636	7694	676	472	0	0	0	0
576	10059	10739	372	1781	1446	1490	15445	7217	165	146	1880	16	0	0
0	0	432	0	247	18979	22442	8945	5274	2341	2140	0	0	0	0
0	0	2061	4762	9791	4992	21940	11283	4813	13012	11106	6245	712	404	0
0	0	7989	2495	21661	12375	6353	10000	5001	5724	12238	243	0	0	0
0	5574	0	7358	10518	20907	17014	8171	10710	21024	9322	18368	2941	8299	1229
0	9408	3319	19157	15643	18575	13158	28340	26950	22469	18906	16501	19432	4704	0
0	3921	5295	12084	19033	39597	13888	25202	15547	16331	17136	7112	5529	5487	0
0	0	0	6207	13938	19245	19284	19734	29795	19016	14579	12005	1954	7436	0
0	0	0	3074	9134	27163	15629	33650	11552	16928	17156	11099	779	137	1782
0	0	0	15863	13831	20085	13864	20583	7212	16552	9265	1058	0	4096	6900
0	0	0	0	16585	22812	15071	12538	11077	27998	31189	9216	6244	6344	5763
0	0	0	0	27851	10161	1213	4694	1996	2835	0	0	0	0	9921
0	0	0	0	0	0	0	6511	7491	794	7024	8713	5704	5388	1934
0	0	0	0	3779	319	0	0	0	0	0	0	0	0	0

Table L-6(o). AVERAGE DAILY VMT ON RAMPS IN THE YEAR 2000

RAMP

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	10184	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1037	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	587	1308	0	0	0	0	0
0	0	0	0	317	0	9061	0	0	0	0	0	0	0	0
0	0	0	0	1052	0	5346	5367	0	0	0	0	0	0	0
0	0	0	0	0	0	0	3553	2613	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table L-6(p). AVERAGE DAILY VMT ON MAJOR ARTERIALS IN THE YEAR 2000

MAAR

0	0	0	13395	11594	15764	16547	23254	9374	8140	6696	2308	41547	0	0
9200	23352	23379	27578	0	18597	19264	3456	2237	0	0	0	36562	0	0
7534	0	1124	5429	3679	9549	42608	25488	9928	6080	5424	1318	21596	0	0
7693	6705	8449	14591	0	1070	36880	15786	4447	16340	3271	1594	23784	0	0
0	7123	723	2705	13009	26533	29247	0	0	31572	0	0	24966	0	0
0	9579	16433	15445	3944	49630	27306	0	1153	42839	0	3831	36027	0	0
5069	33573	6710	30794	22209	55539	125676	23402	11066	18003	566	31520	32942	0	0
1433	22042	40371	55099	96081	102693	97899	145423	161663	170762	94035	14646	2545	1079	9416
0	0	2307	24439	42807	35749	44491	92934	946	25942	0	0	0	2956	21948
0	0	0	26006	62608	62561	25493	73890	44393	52421	0	0	8864	2755	25899
0	0	4632	0	7176	353	27371	26958	601	45956	0	0	11936	13168	29025
0	0	295	5650	9795	0	27102	51039	0	69101	4847	4935	0	195	16304
0	0	0	0	10029	32317	859	20329	0	77475	0	1485	22255	14864	20778
0	0	0	9028	10148	993	0	10796	2202	18278	1518	0	5691	16443	21316
0	0	0	0	3791	0	0	1044	2021	18912	12152	0	1056	1660	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table L-7(a). PROJECTED VEHICULAR EMISSIONS OF CARBON MONOXIDE FOR THE DENVER METRO GRID IN 1975 (UNITS ARE KG/MI^2/DAY)

Row no.	Column number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	0	0	0	872	488	83	116	693	82	30	54	515	391	85	0
15	143	117	150	194	1910	683	458	1,519	312	98	384	416	346	23	0
14	147	63	215	208	446	1255	704	3,362	424	354	895	286	67	24	0
13	150	67	231	164	253	1634	1598	3,629	863	1136	197	5	78	26	0
12	0	146	238	239	742	1911	3584	5,706	2060	1895	181	75	74	26	0
11	0	113	414	815	2514	3656	2227	4,561	2410	1596	331	81	132	26	0
10	17	858	666	1824	3051	5306	7689	8,819	5864	4124	1765	2024	682	216	6
9	88	1240	1136	1572	3633	4924	7555	12,423	7890	5426	4123	2747	700	374	329
8	0	320	1204	1924	3748	5992	7144	11,115	5988	3096	2052	1757	345	53	50
7	0	0	130	643	1970	3325	3569	7,389	7268	3484	1449	738	117	24	58
6	0	0	178	268	1145	2472	2878	6,337	3479	3496	1578	685	117	34	74
5	0	0	87	427	695	459	3464	2,864	1334	2146	797	124	132	44	52
4	0	0	0	148	595	715	1330	1,652	1272	823	1558	335	482	78	63
3	0	0	0	72	484	847	740	495	477	200	587	74	259	96	71
2	0	0	0	0	520	117	228	46	34	50	436	36	16	169	5
1	0	0	0	0	181	23	106	0	0	0	0	0	0	0	0

Table L-7(b). PROJECTED VEHICULAR EMISSIONS OF CARBON MONOXIDE FOR THE DENVER METRO GRID IN 1980 (UNITS ARE KG/MI^2/DAY)

Row no.	Column number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	0	0	0	546	306	97	119	519	56	36	53	335	282	49	0
15	82	99	132	186	1206	498	350	1116	223	69	253	274	263	20	0
14	79	50	180	180	261	931	501	2141	300	214	576	221	79	17	0
13	83	43	193	199	177	1162	1030	2245	476	691	166	5	83	18	0
12	0	77	204	208	488	1119	2124	3568	1276	1081	102	46	86	19	0
11	0	74	313	660	1433	2234	1452	2731	1347	990	179	58	144	19	0
10	19	481	332	1112	1864	2910	4401	5200	3272	2473	1105	1389	532	158	7
9	53	691	680	941	2130	2665	4508	6850	4317	3151	2218	1593	460	241	240
8	0	242	800	1120	2361	3454	4122	6508	3465	1894	1262	1174	266	54	69
7	0	0	140	462	1206	1858	1973	4393	4310	2212	989	603	140	34	80
6	0	0	180	185	961	1674	1910	3889	2077	2335	1185	599	152	42	97
5	0	0	75	474	549	289	2320	1627	796	1731	676	104	141	60	73
4	0	0	0	192	524	678	1037	906	812	753	1494	338	438	92	84
3	0	0	0	102	531	669	613	429	402	208	441	99	219	92	99
2	0	0	0	0	362	88	190	64	48	65	336	50	23	119	6
1	0	0	0	0	122	20	95	0	0	0	0	0	0	0	0

Table L-7(c). PROJECTED VEHICULAR EMISSIONS OF CARBON MONOXIDE FOR THE DENVER METRO GRID IN 1985 (UNITS ARE KG/MI^2/DAY)

Row no.	Column number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	0	0	0	271	152	64	76	288	34	24	34	171	153	23	0
15	38	58	79	116	602	272	197	613	120	37	130	141	147	12	0
14	35	29	106	107	123	514	270	1075	161	103	284	125	52	9	0
13	38	22	113	133	95	626	521	1104	213	335	97	4	54	10	0
12	0	33	121	124	250	527	1010	1768	628	498	47	23	57	10	0
11	0	38	174	381	660	1088	740	1310	610	488	79	32	94	10	0
10	12	218	134	541	908	1295	2034	2464	1479	1188	548	732	302	87	4
9	26	312	326	451	1004	1172	2156	3063	1916	1474	969	744	236	122	132
8	0	135	413	525	1176	1605	1918	3065	1616	923	618	608	150	34	48
7	0	0	91	250	588	841	884	2095	2051	1107	520	350	94	23	55
6	0	0	114	98	564	876	986	1900	993	1210	658	358	104	29	66
5	0	0	44	310	313	144	1204	747	380	998	399	61	91	42	51
4	0	0	0	133	314	419	588	403	408	459	927	213	266	61	58
3	0	0	0	71	345	382	358	255	236	133	245	68	129	57	68
2	0	0	0	0	192	48	111	44	33	44	189	35	16	64	4
1	0	0	0	0	64	12	57	0	0	0	0	0	0	0	0

Table L-7(d). PROJECTED VEHICULAR EMISSIONS OF HYDROCARBONS FOR THE DENVER METRO GRID IN 1975 (UNITS ARE KG/MI^2/DAY)

Row no.	Column number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	0	0	0	104	52	8	12	86	6	3	6	60	43	10	0
15	15	12	16	20	223	71	49	174	32	10	43	49	38	2	0
14	16	6	22	21	51	150	74	376	44	39	104	32	7	2	0
13	16	7	24	17	28	188	172	415	89	132	21	0	8	3	0
12	0	16	25	25	76	202	393	675	239	204	18	7	8	3	0
11	0	12	42	85	264	400	238	540	275	180	34	8	14	3	0
10	2	96	77	212	342	580	856	1034	656	466	211	227	79	25	1
9	10	134	124	166	385	521	850	1314	832	576	432	295	73	42	38
8	0	34	144	218	426	672	803	1227	635	332	217	192	37	6	5
7	0	0	15	68	205	350	373	808	810	376	152	85	12	2	6
6	0	0	20	30	131	274	321	684	382	402	174	78	12	4	8
5	0	0	11	47	74	47	374	301	142	254	86	13	14	4	5
4	0	0	0	16	64	75	143	171	134	86	181	36	51	8	6
3	0	0	0	8	53	94	83	53	51	22	72	8	27	10	7
2	0	0	0	0	56	13	25	5	4	5	54	4	2	18	0
1	0	0	0	0	19	2	11	0	0	0	0	0	0	0	0

Table L-7(e). PROJECTED VEHICULAR EMISSIONS OF HYDROCARBONS FOR THE DENVER METRO GRID IN 1980 (UNITS ARE KG/MI^2/DAY)

Row no.	Column number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	0	2	0	61	31	9	12	59	5	4	5	36	29	6	0
15	8	10	13	18	131	49	35	119	22	7	26	30	27	2	0
14	8	5	18	18	28	103	50	225	29	22	61	23	8	2	0
13	8	4	19	20	18	124	104	241	46	75	17	0	8	2	0
12	0	8	20	20	47	112	220	396	140	109	10	4	8	2	0
11	0	7	30	66	142	231	148	302	144	105	17	6	14	2	0
10	2	50	36	121	197	298	458	568	343	264	123	146	57	17	1
9	6	70	70	94	215	266	477	684	430	318	219	162	45	25	26
8	0	25	89	120	254	363	435	679	347	194	126	121	47	5	7
7	0	0	16	48	121	185	195	457	451	225	98	65	14	3	8
6	0	0	20	20	104	175	202	401	216	252	123	64	15	4	10
5	0	0	9	49	55	28	240	161	80	189	69	10	14	6	7
4	0	0	0	20	53	67	106	89	81	74	159	34	44	9	8
3	0	0	0	11	55	71	66	44	41	21	49	10	22	9	10
2	0	0	0	0	37	10	19	6	5	6	38	5	2	12	1
1	0	0	0	0	12	2	10	0	0	0	0	0	0	0	0

Table L-7(f). PROJECTED VEHICULAR EMISSIONS OF HYDROCARBONS FOR THE DENVER METRO GRID IN 1985 (UNITS ARE $KG/MI^2/DAY$)

Row no.	Column number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	0	0	0	34	17	7	8	37	4	3	4	20	18	3	0
15	4	6	9	13	75	30	22	75	13	4	15	17	17	1	0
14	4	3	12	12	15	64	30	129	18	12	34	15	6	1	0
13	4	2	13	15	11	76	60	136	24	42	11	0	6	1	0
12	0	4	14	14	28	60	120	225	79	57	5	2	6	1	0
11	0	4	19	43	74	128	87	166	74	59	9	4	10	1	0
10	1	26	16	67	110	151	241	308	177	146	70	88	37	11	0
9	3	36	38	51	116	133	261	348	217	170	108	86	26	15	16
8	0	16	52	64	145	192	231	366	184	108	70	72	17	4	5
7	0	0	12	30	68	95	99	251	245	128	59	43	11	2	6
6	0	0	14	12	70	105	120	226	119	150	78	43	12	3	7
5	0	0	6	36	36	16	143	84	43	124	46	7	10	4	6
4	0	0	0	16	36	47	69	45	46	52	112	24	30	7	6
3	0	0	0	9	41	47	44	30	28	16	31	8	15	6	8
2	0	0	0	0	22	6	13	5	4	5	24	4	2	7	0
1	0	0	0	0	7	1	7	0	0	0	0	0	0	0	0

Table L-7(g). PROJECTED VEHICULAR EMISSIONS OF NITROGEN OXIDES FOR DENVER METRO GRID IN 1975
(UNITS ARE KG/MI^2/DAY)

Row no.	Column number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	0	0	0	44	17	2	3	39	2	1	2	23	15	4	0
15	5	4	5	6	90	22	16	68	9	3	16	20	14	1	0
14	5	2	7	6	20	64	24	138	13	14	41	12	2	1	0
13	5	2	8	6	10	73	58	160	26	52	7	0	2	1	0
12	0	5	8	7	22	64	138	281	96	69	5	2	2	1	0
11	0	4	13	26	83	138	78	225	106	68	10	3	4	1	0
10	0	35	31	85	127	201	311	421	241	175	90	85	31	10	0
9	4	45	43	53	123	165	317	415	262	185	134	98	22	15	15
8	0	11	60	82	163	249	298	435	202	109	69	66	12	2	2
7	0	0	6	22	63	110	114	281	294	126	47	34	4	1	2
6	0	0	8	12	51	99	116	229	133	158	61	30	4	1	2
5	0	0	5	17	24	14	125	94	45	106	29	4	5	1	2
4	0	0	0	6	21	23	47	51	42	26	73	12	16	2	2
3	0	0	0	3	18	33	30	18	17	7	32	2	8	3	2
2	0	0	0	0	19	5	8	1	1	2	24	1	0	5	0
1	0	0	0	0	6	1	4	0	0	0	0	0	0	0	0

Table L-7(h). PROJECTED VEHICULAR EMISSIONS OF NITROGEN OXIDES FOR THE DENVER METRO GRID IN 1980 (UNITS ARE KG/MI^2/DAY)

Row no.	Column number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	0	0	0	45	17	5	6	45	3	2	3	23	17	4	0
15	5	5	7	10	92	26	19	81	11	3	16	21	16	1	0
14	4	2	9	10	18	75	27	145	15	13	41	14	4	1	0
13	5	2	11	11	11	83	60	164	24	52	9	0	4	1	0
12	0	4	11	11	24	60	136	292	100	062	4	2	4	1	0
11	0	4	16	35	77	140	87	223	96	70	8	3	7	1	0
10	1	31	25	85	129	177	286	404	218	178	92	95	39	12	0
9	4	41	42	52	123	144	312	370	231	180	115	93	24	16	18
8	0	14	66	80	173	233	281	425	190	114	68	74	15	3	4
7	0	0	12	29	68	99	102	285	285	130	53	45	8	2	4
6	0	0	14	13	74	112	132	243	134	175	76	42	8	2	5
5	0	0	7	30	30	14	146	86	44	135	41	6	8	3	3
4	0	0	0	14	29	36	63	45	43	39	107	19	24	4	4
3	0	0	0	7	34	46	45	27	25	13	36	6	12	5	5
2	0	0	0	0	21	7	11	3	2	3	28	2	1	6	0
1	0	0	0	0	7	1	5	0	0	0	0	0	0	0	0

Table L-7(i). PROJECTED VEHICULAR EMISSIONS OF NITROGEN OXIDES FOR THE DENVER METRO GRID IN 1985 (UNITS ARE KG/MI^2/DAY)

Row no.	Column number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	0	0	0	33	12	5	5	36	2	2	2	16	14	3	0
15	3	4	6	9	68	21	16	65	9	3	12	15	13	1	0
14	3	2	8	9	12	60	21	108	12	10	29	11	4	1	0
13	3	2	9	11	8	65	45	120	16	38	8	0	4	1	0
12	0	3	10	10	18	42	97	217	75	41	3	2	4	1	0
11	0	3	13	30	52	102	68	160	64	52	5	2	7	1	0
10	1	20	15	61	95	116	194	283	146	131	68	74	33	10	0
9	2	28	30	36	89	93	224	245	151	128	73	65	18	12	15
8	0	12	51	57	131	161	195	302	131	85	49	58	12	3	4
7	0	0	12	24	52	66	68	209	202	97	41	38	8	2	4
6	0	0	14	10	65	88	104	184	97	137	63	37	8	2	5
5	0	0	6	29	26	10	116	59	31	114	36	5	8	3	4
4	0	0	0	14	26	32	55	30	32	35	96	18	22	4	4
3	0	0	0	8	33	41	40	24	23	13	29	6	11	5	5
2	0	0	0	0	17	6	9	3	2	3	23	3	1	5	0
1	0	0	0	0	5	1	5	0	0	0	0	0	0	0	0

Table L-8(a). FUNCTIONAL-SYSTEM ANNUAL TRAVEL BY URBAN AREA (IN MILLIONS OF VEHICLE MILES) - 1968

	Freeway and expressway	Principal arterial	Minor arterial	Collector	Local
Boulder	34.68	55.94	39.31	10.98	12.43
Ft. Collins	0	60.18	28.94	8.21	10.92
Greeley	18.77	27.40	39.39	9.79	11.26

Table L-8(b). FUNCTIONAL-SYSTEM ANNUAL TRAVEL BY URBAN AREA (IN MILLIONS OF VEHICLE MILES) - 1990

	Freeway and expressway	Principal arterial	Minor arterial	Collector	Local
Boulder	70.73	101.28	104.42	29.85	43.05
Ft. Collins	5.00	100.63	63.07	19.69	15.90
Greeley	41.04	56.36	71.11	17.17	23.84

Table L-9. ROAD CLASSIFICATION AND SPEEDS FOR BOULDER, FT. COLLINS, AND GREELEY

Classification	Speed (mi/hr)
Freeway and expressway	34
Principal arterial	26
Minor arterial	23
Collector	21
Local	20